Fig.1

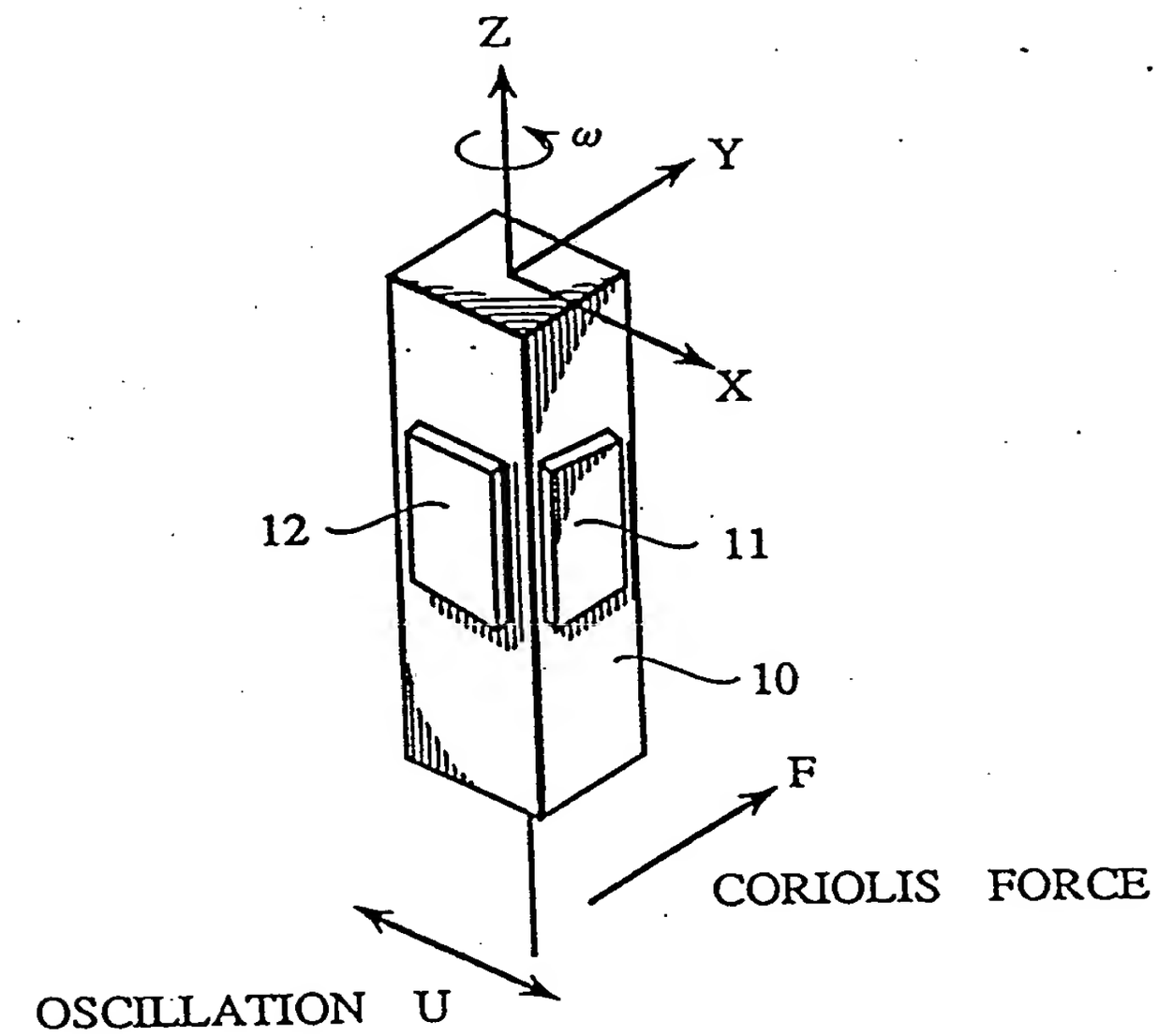
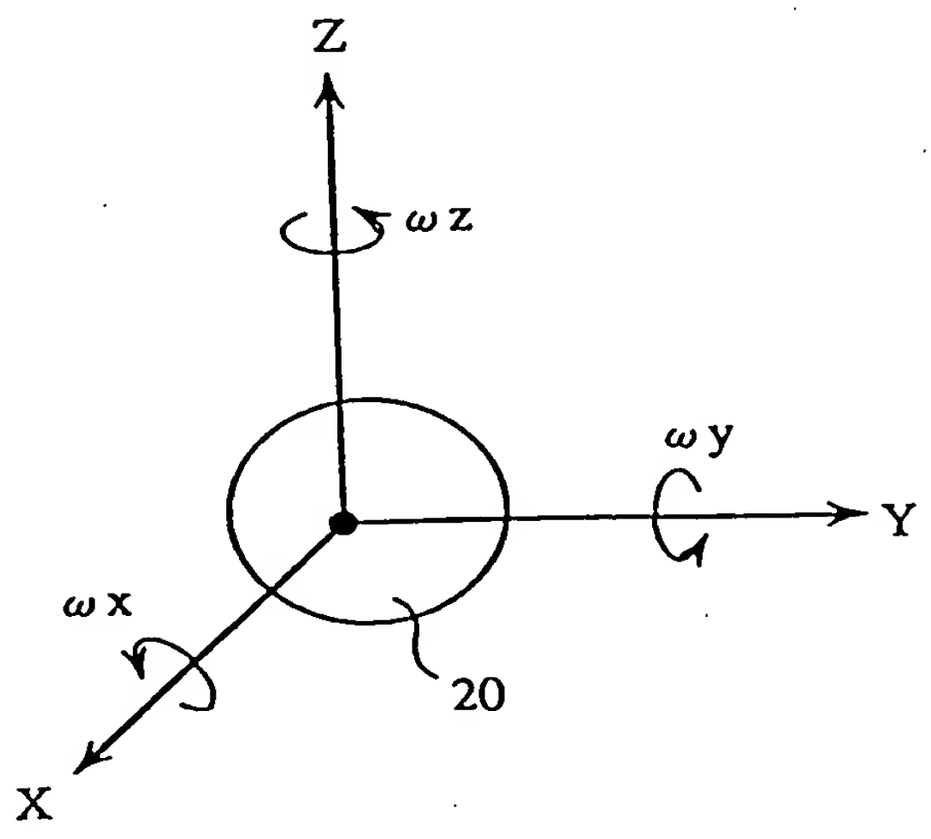


Fig.2



85

Fig.3

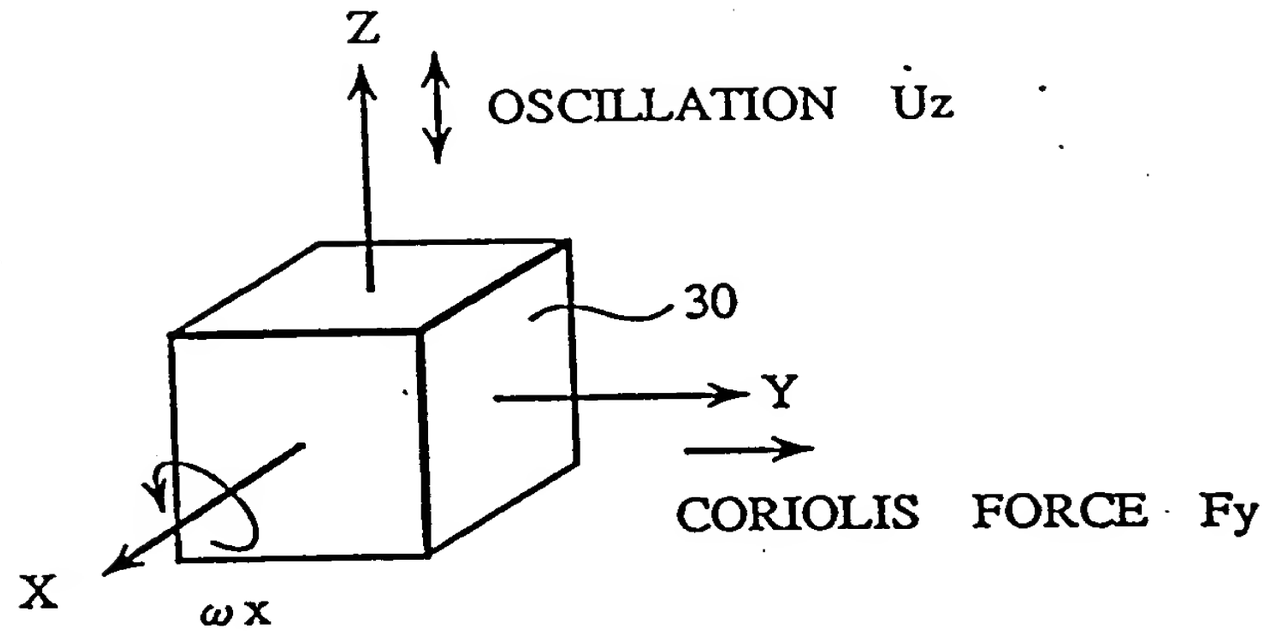


Fig.4

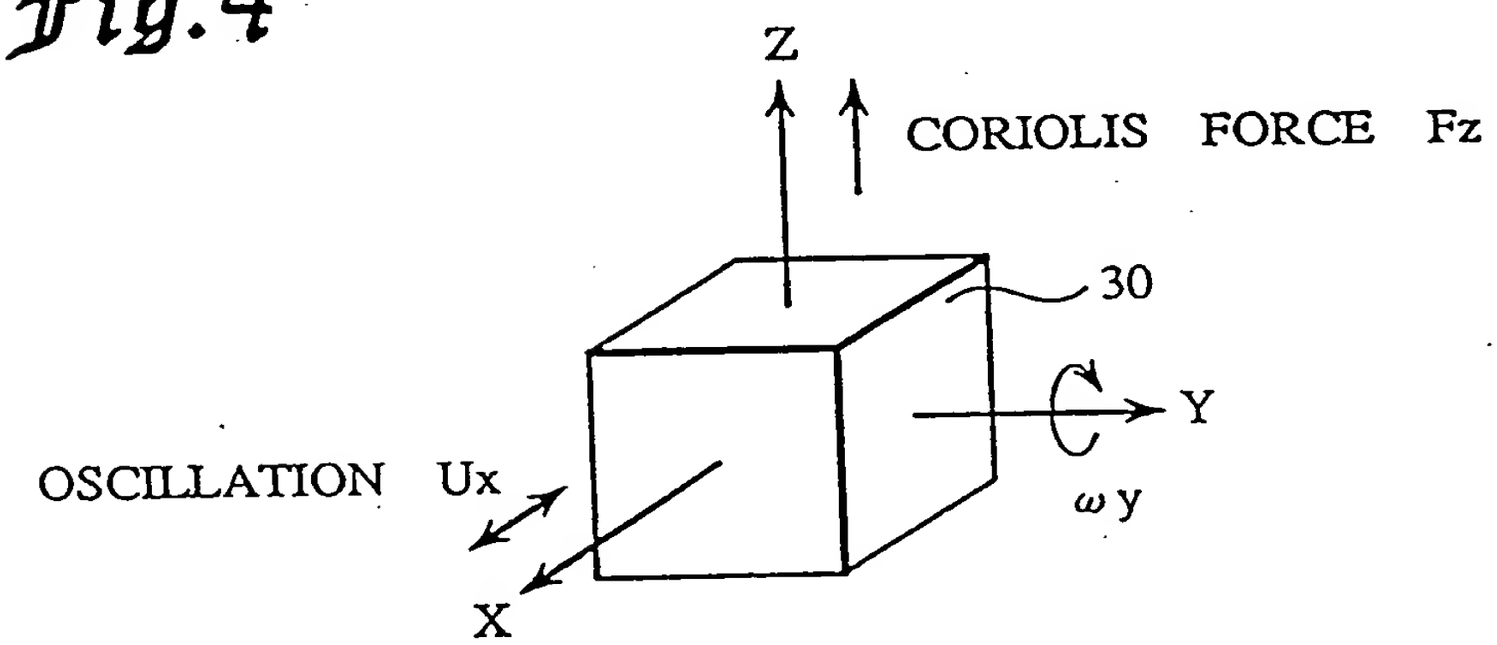


Fig.5

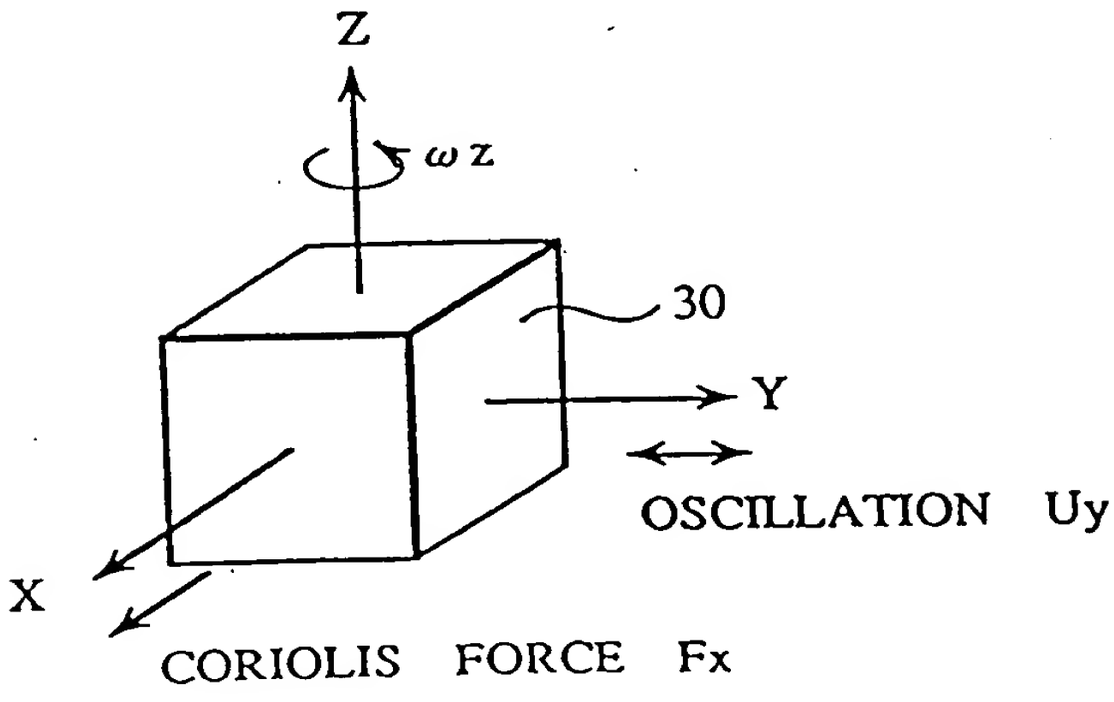


Fig.6

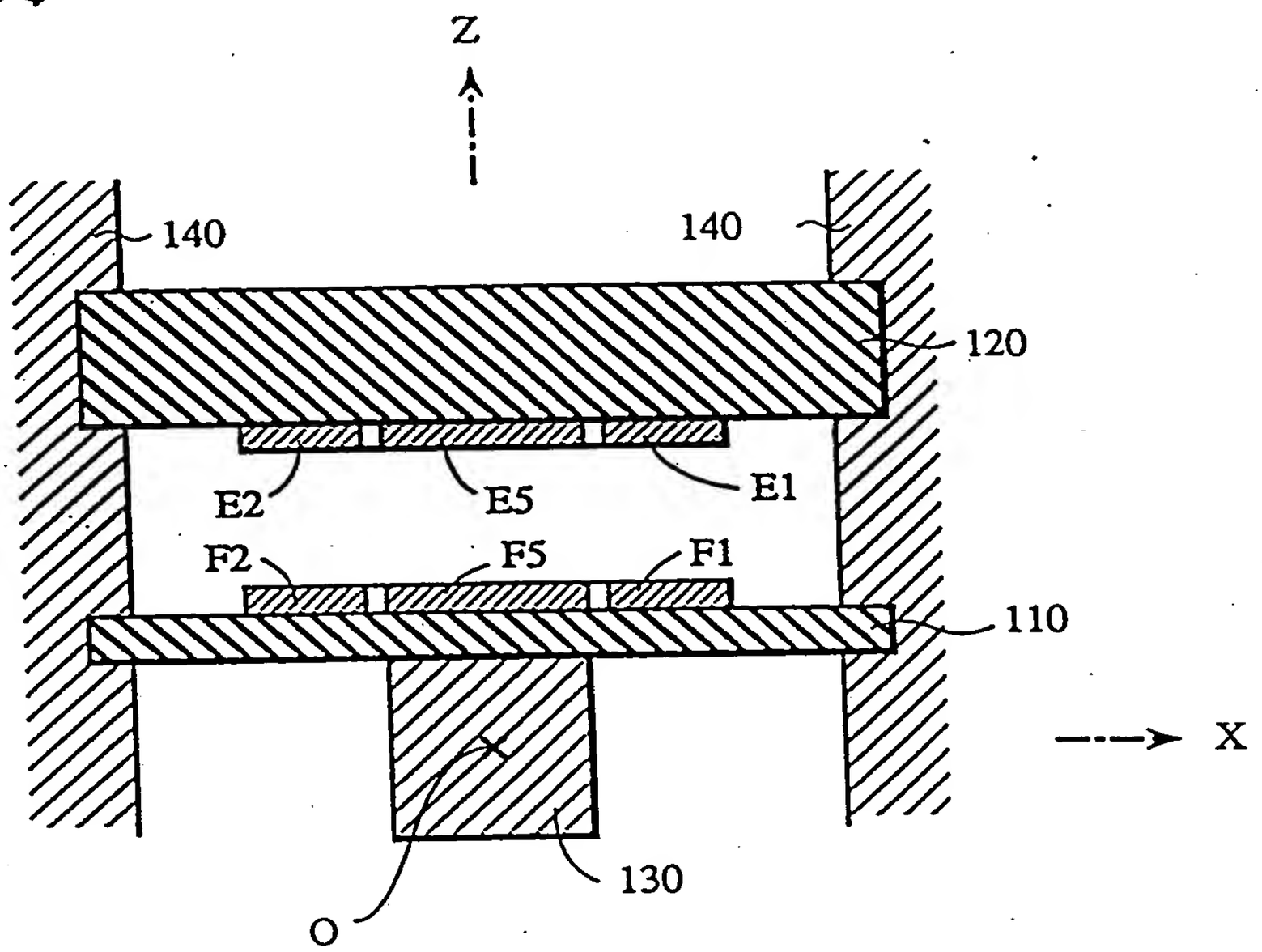


Fig.7

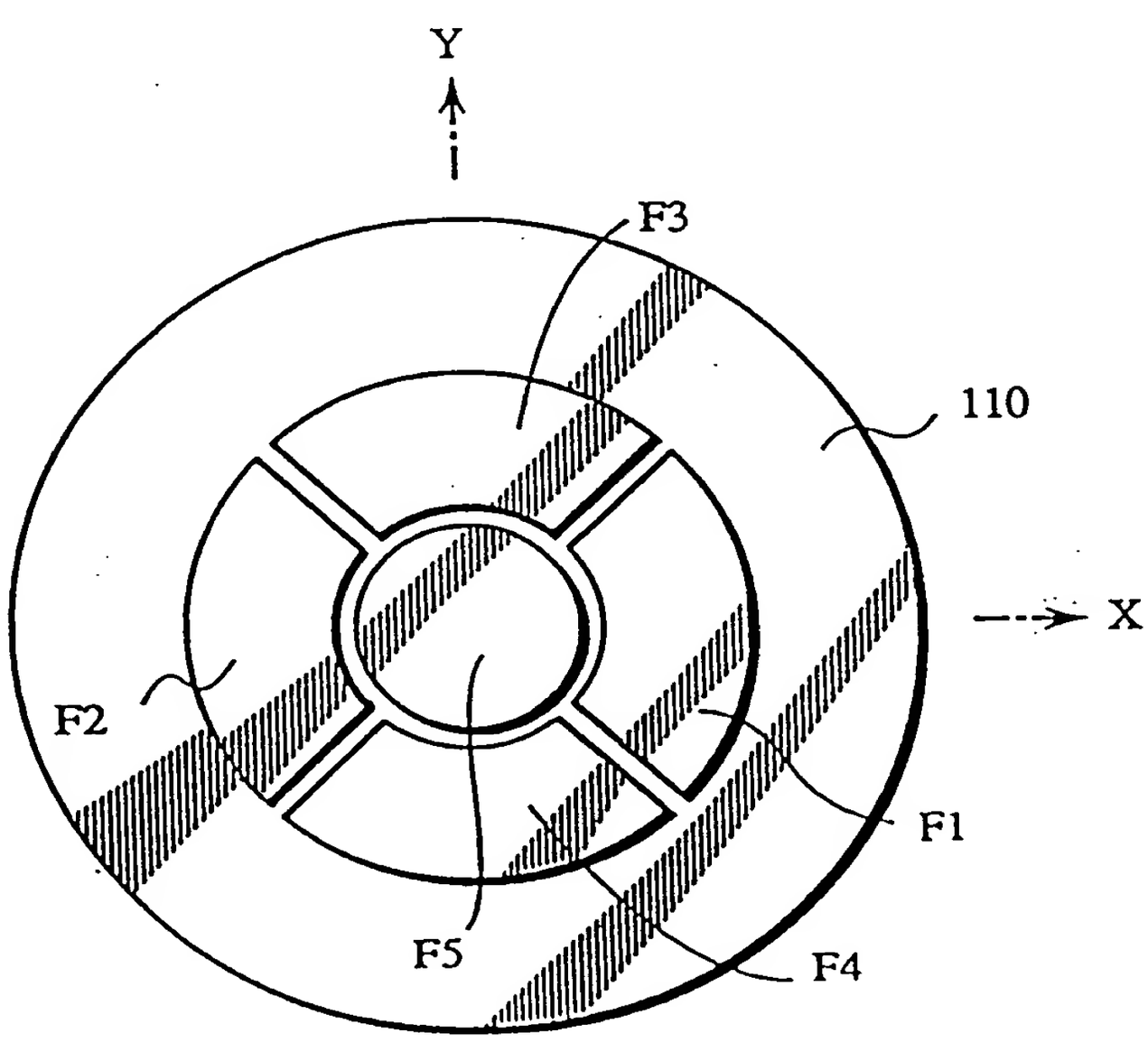


Fig.8

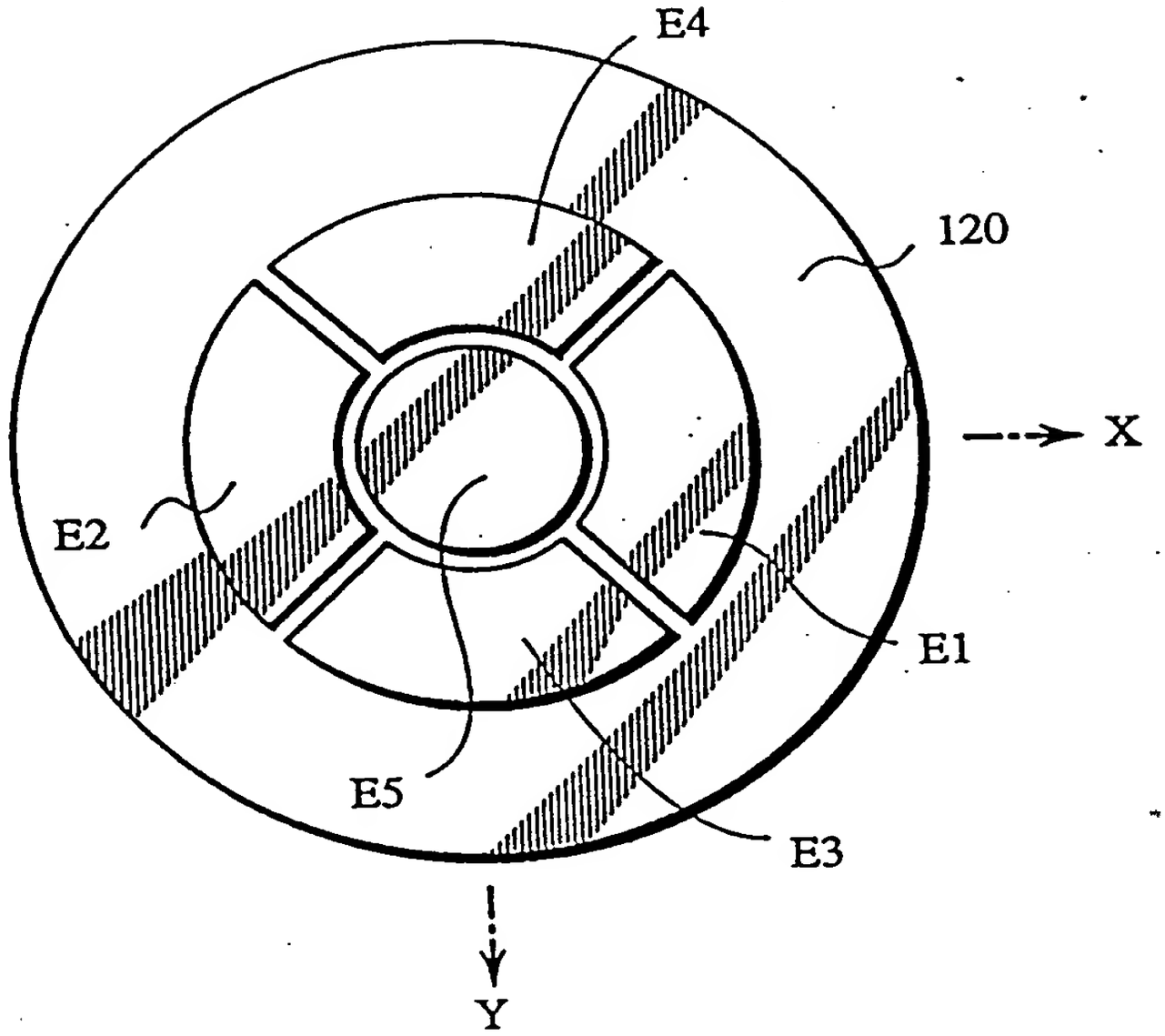


Fig.9

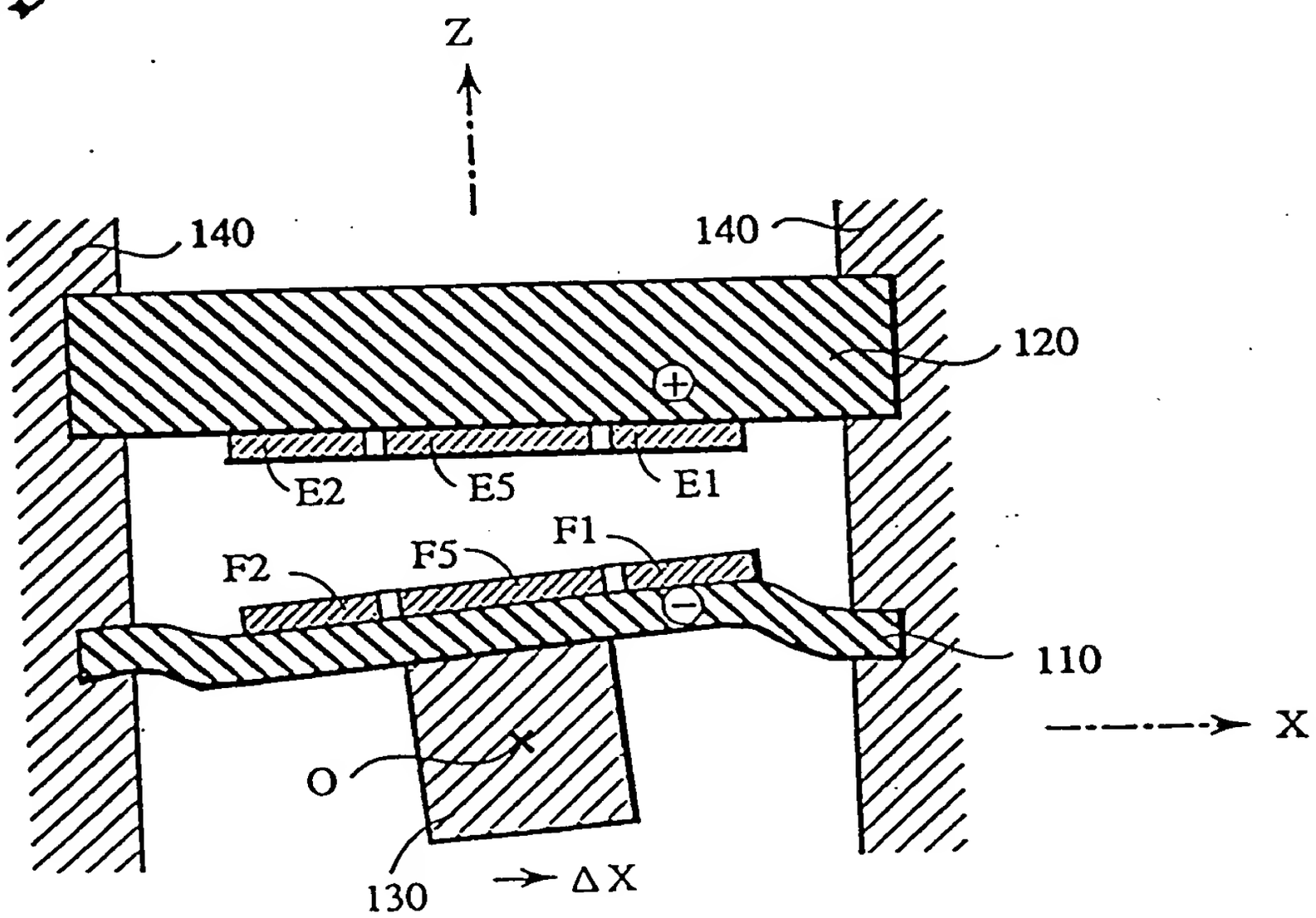


Fig.10

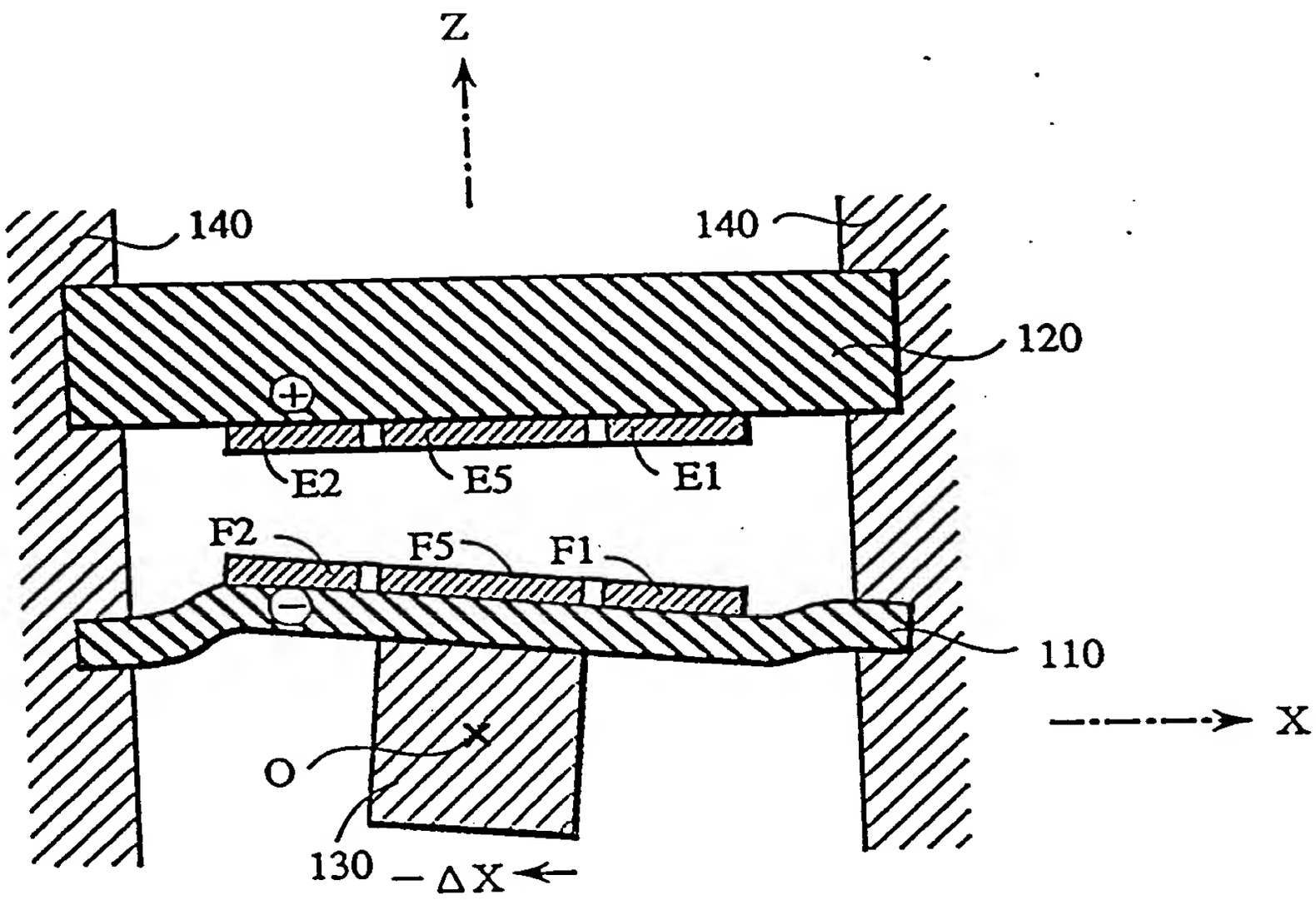

Z
140
140
120
E2
E5
E1
F2
F5
F1
110
X
O
130
−ΔX

Fig.11

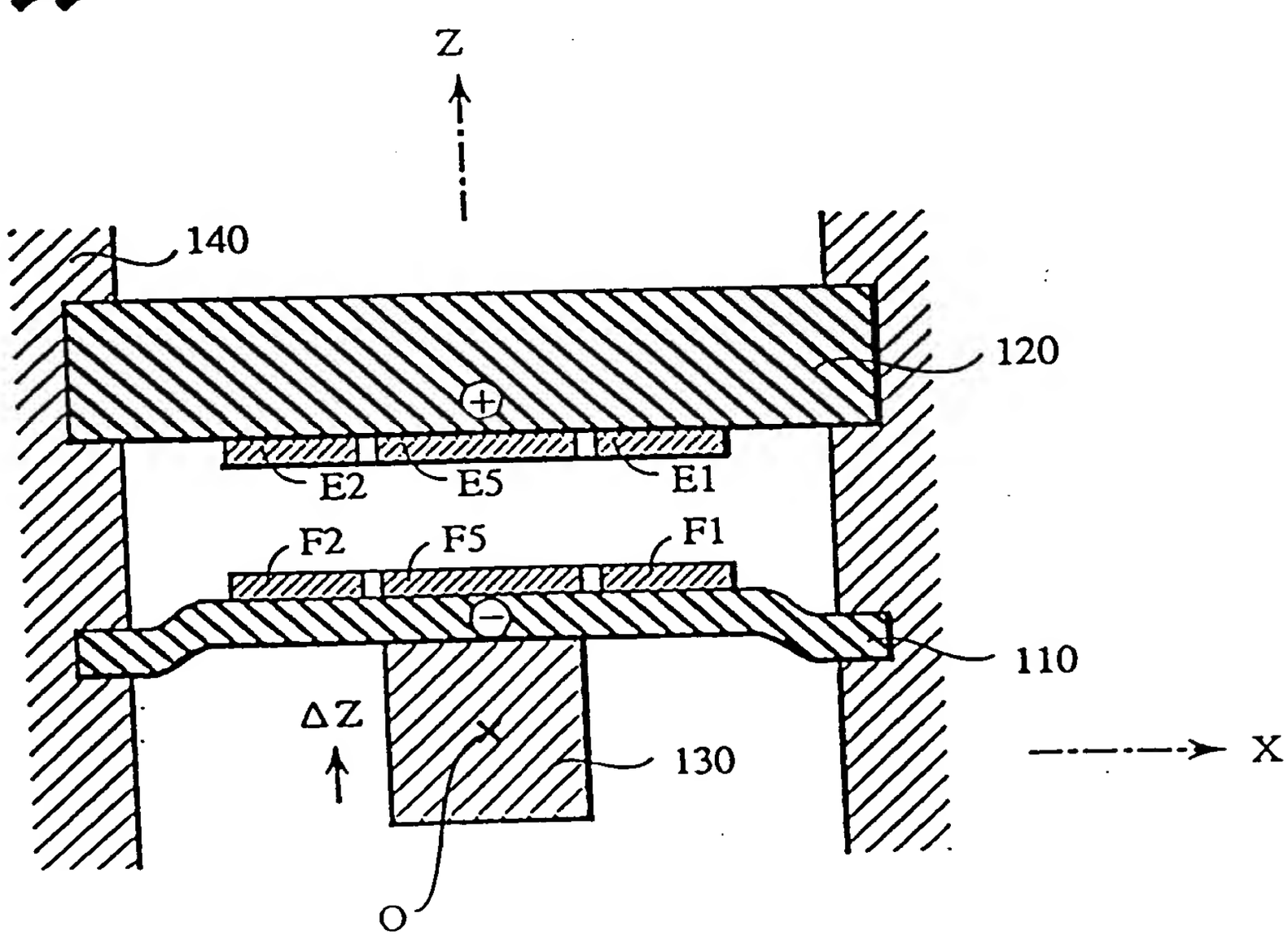

Z
140
120
E2
E5
E1
F2
F5
F1
110
ΔZ
130
X
O

Fig.12

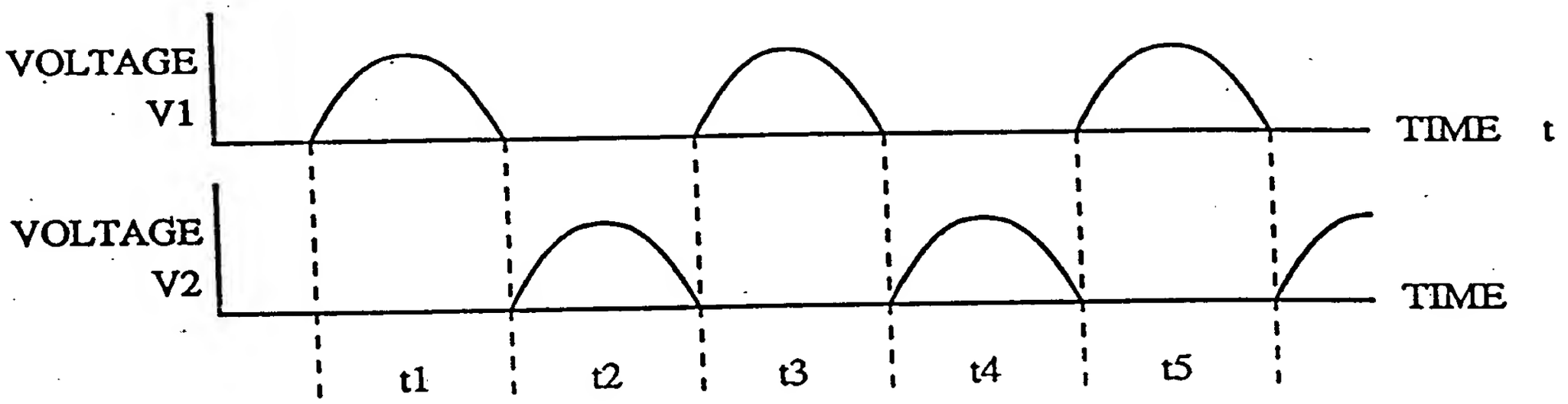


Fig.13

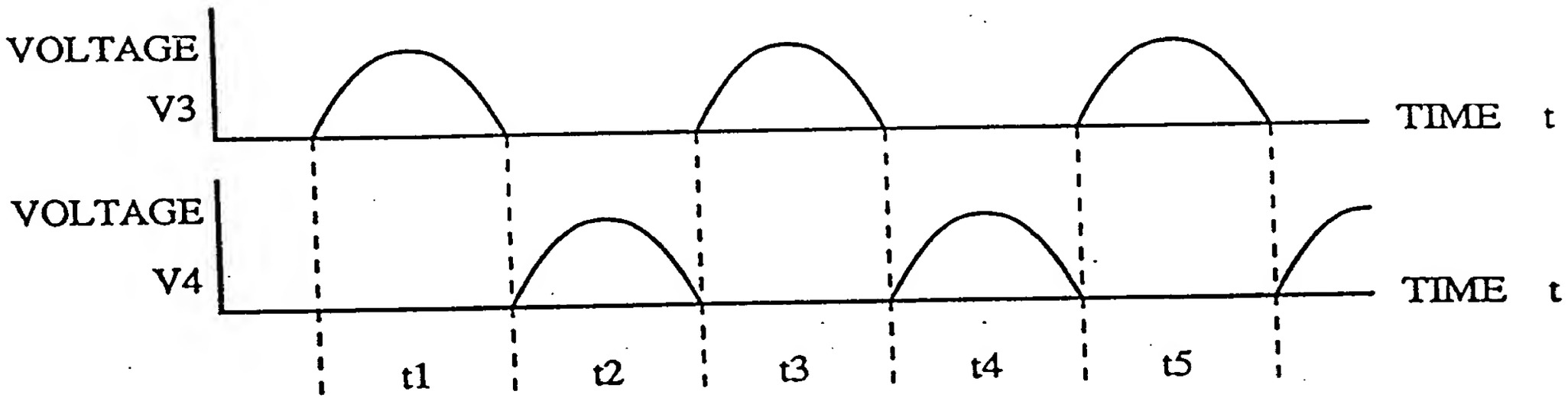


Fig.14

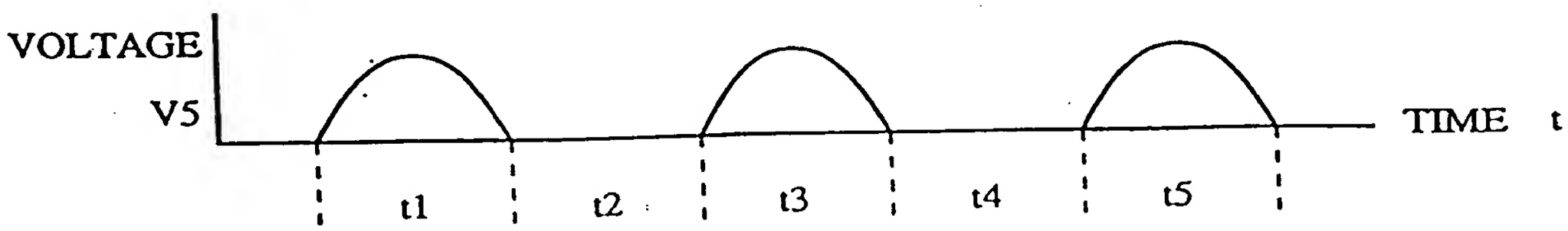


Fig.15

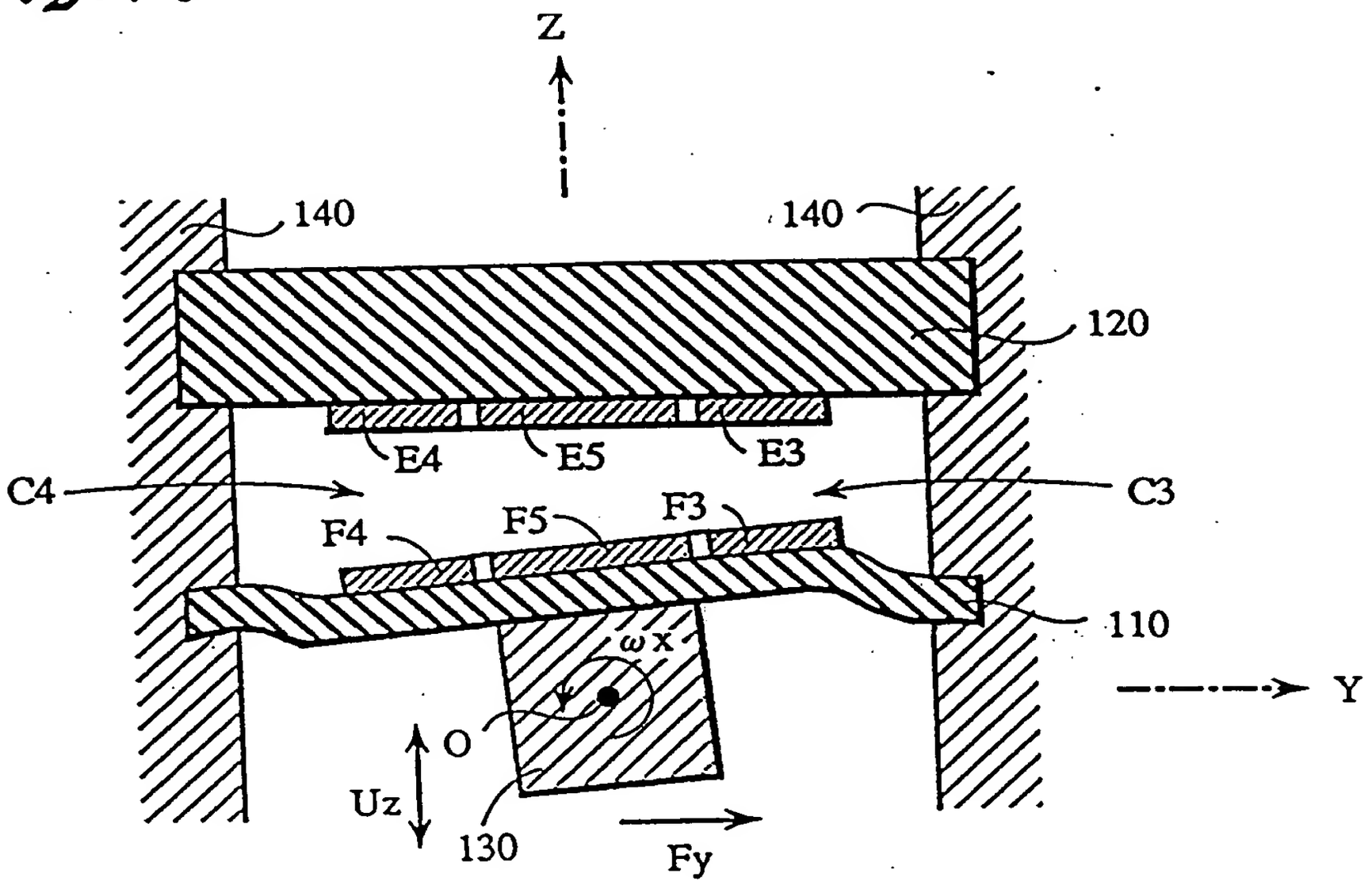

Z
140
140
120
E4
E5
E3
C4
C3
F4
F5
F3
110
ωx
Y
O
Uz
130
Fy

Fig.16

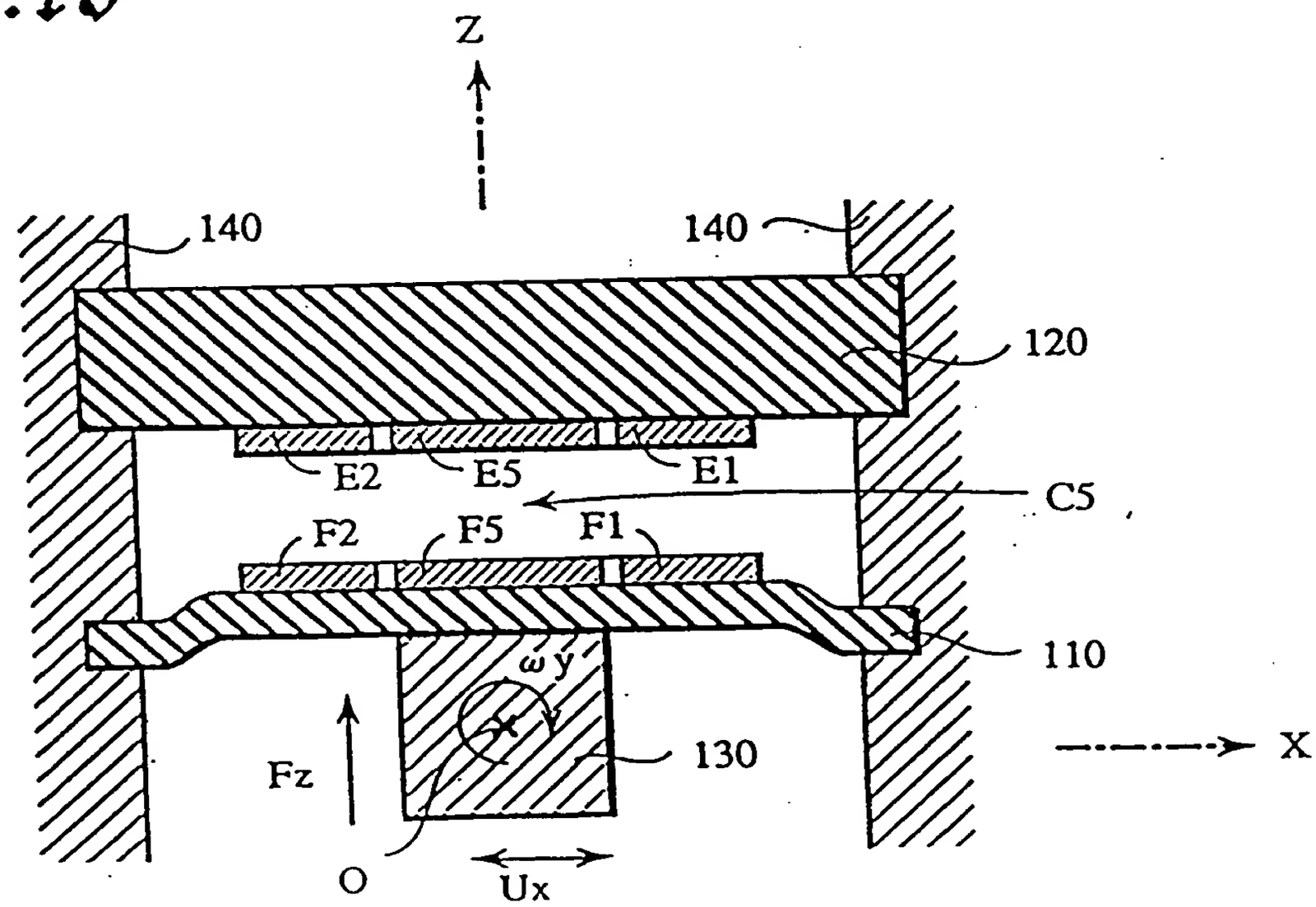

Z
140
140
120
E2
E5
E1
C5
F2
F5
F1
110
ωy
130
X
Fz
O
Ux

Fig.17

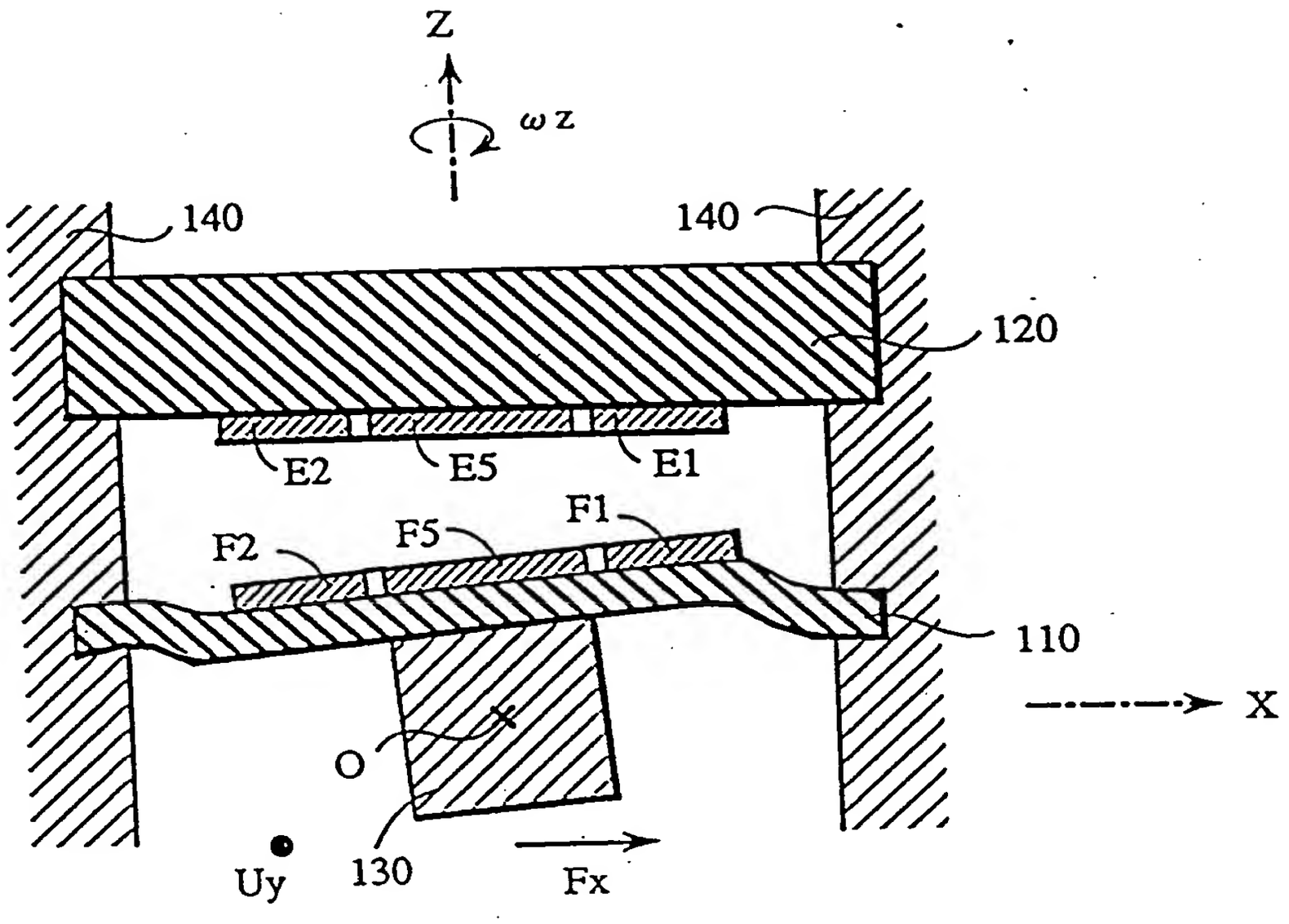

Z
ωz
140
140
120
E2
E5
E1
F1
F5
F2
110
X
O
Uy
130
Fx

Fig.18

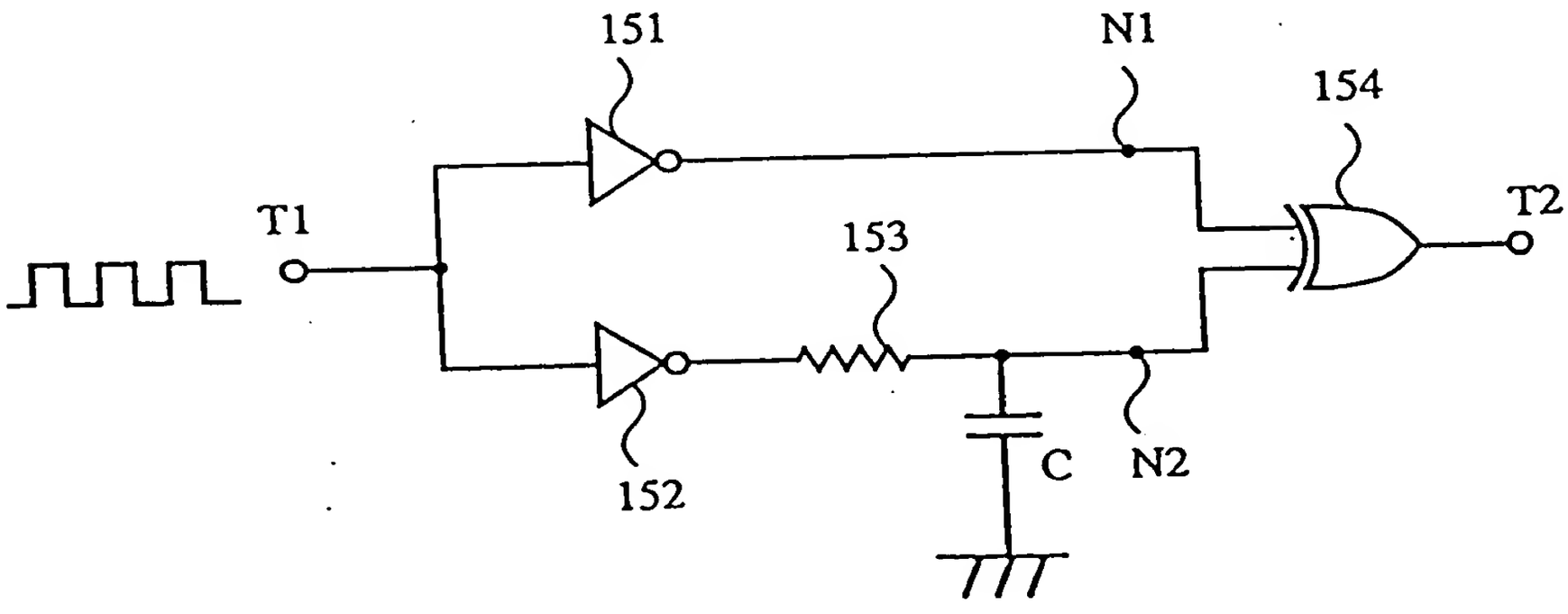

151
N1
154
T1
153
T2
152
C
N2

Fig.19

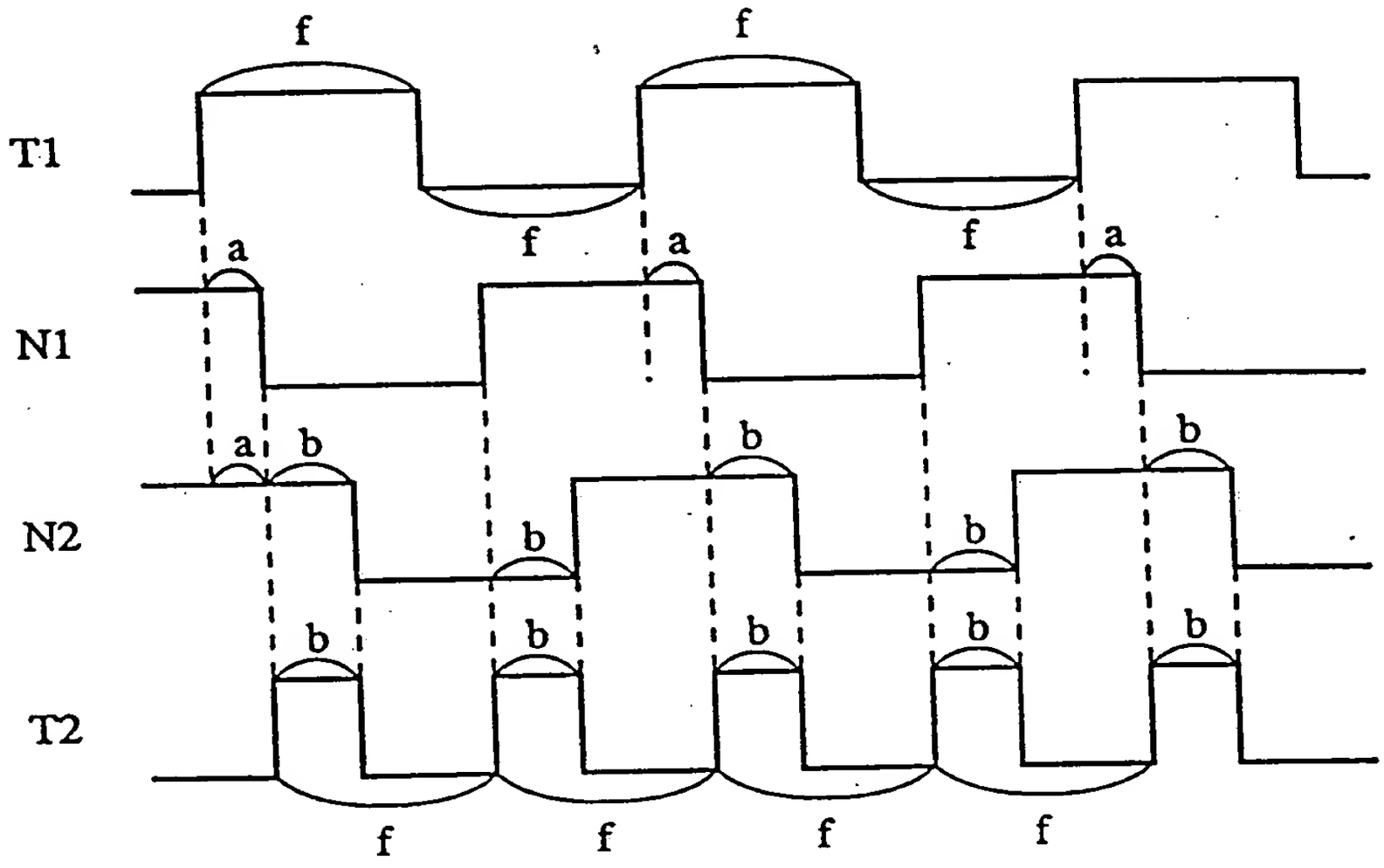


Fig.20

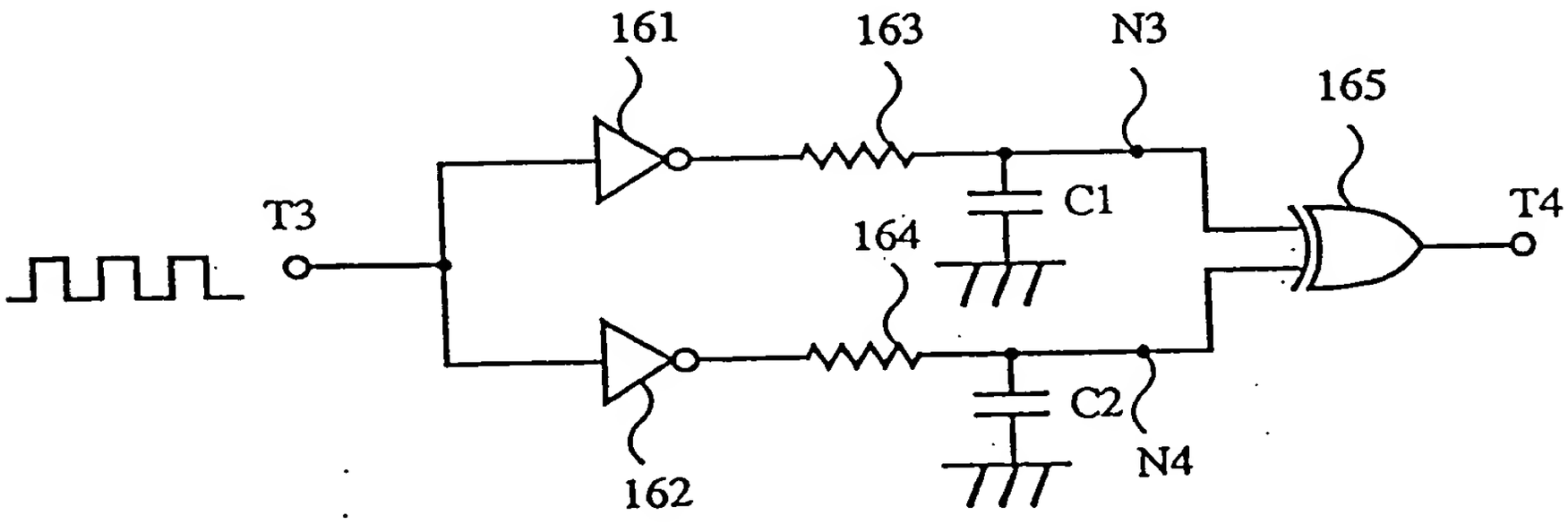


Fig.21

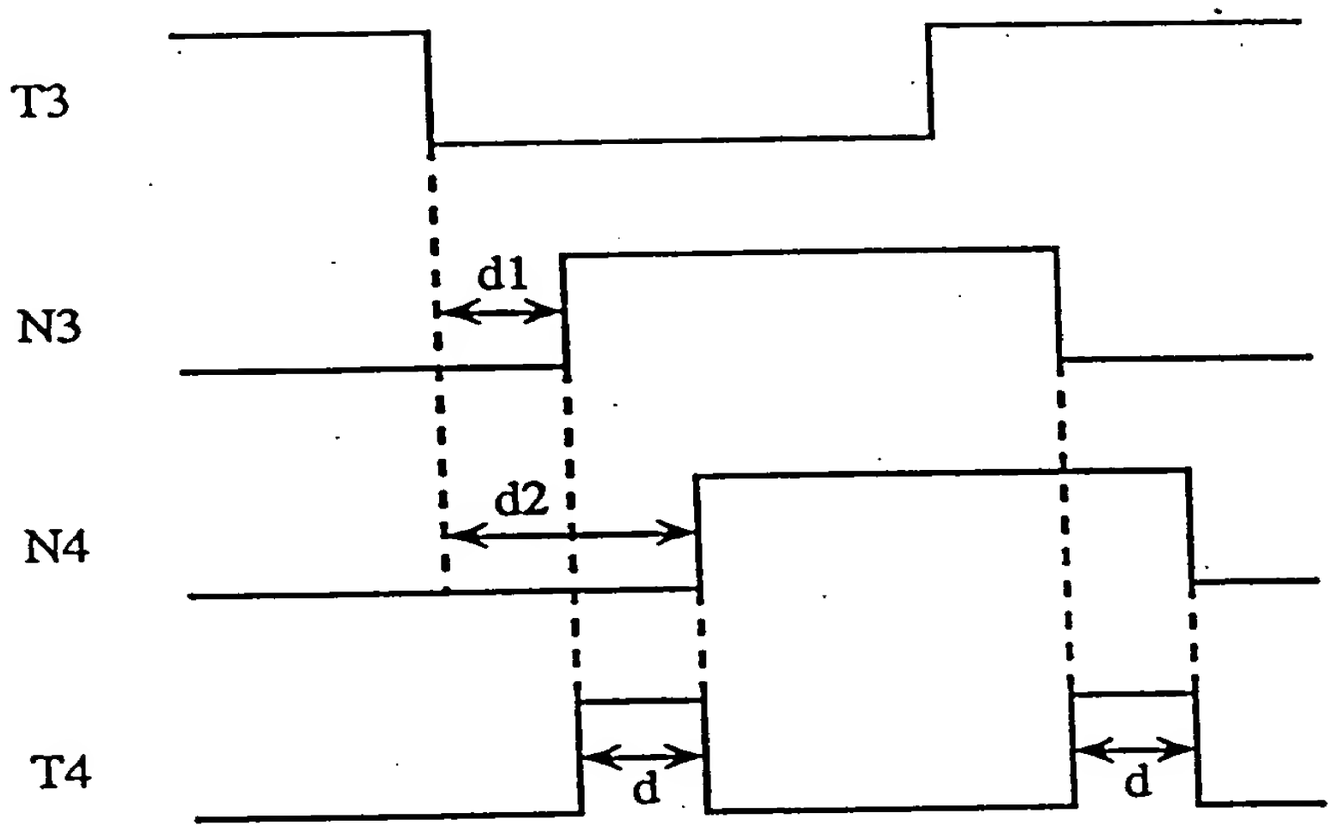


Fig.22

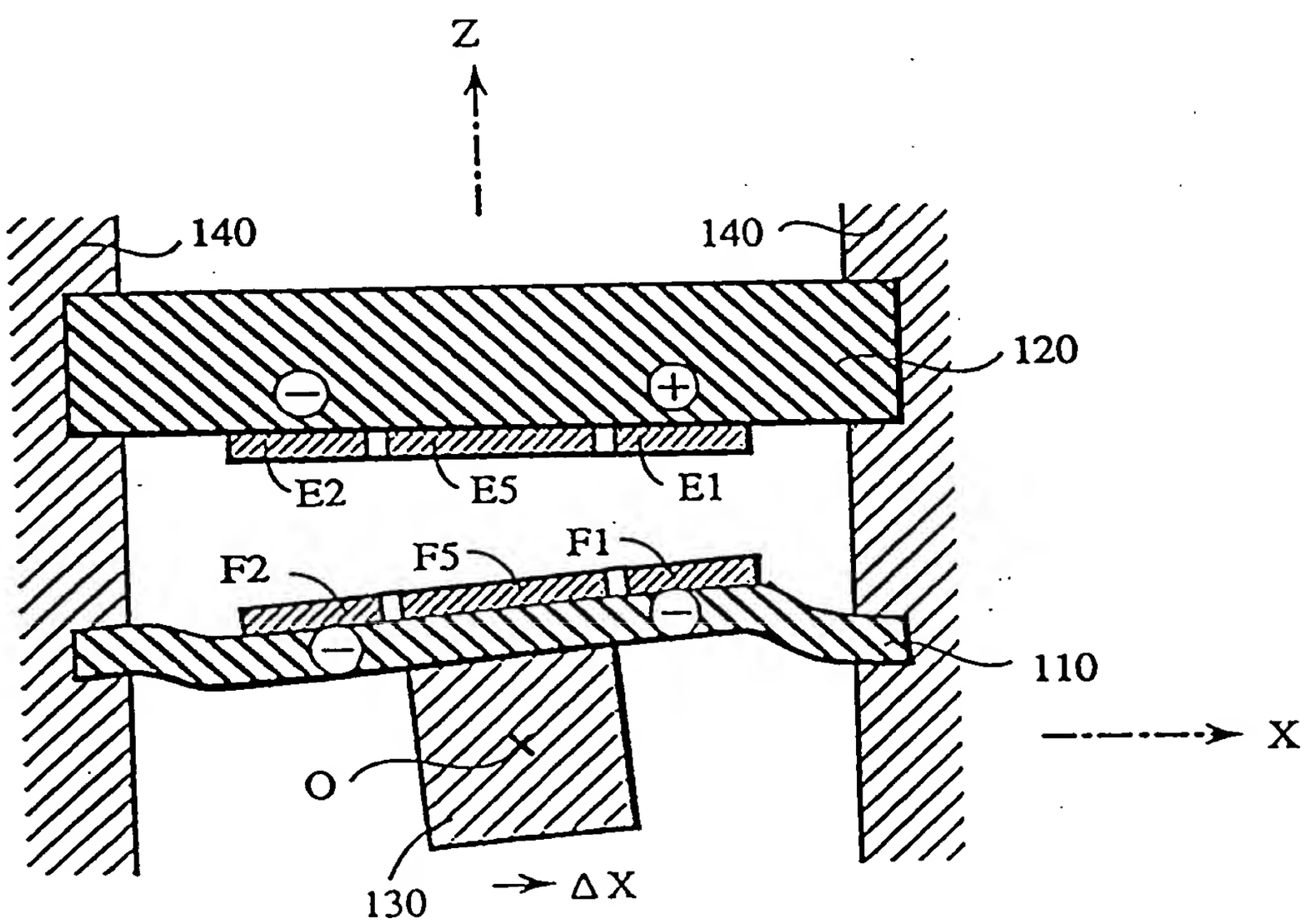


Fig.23

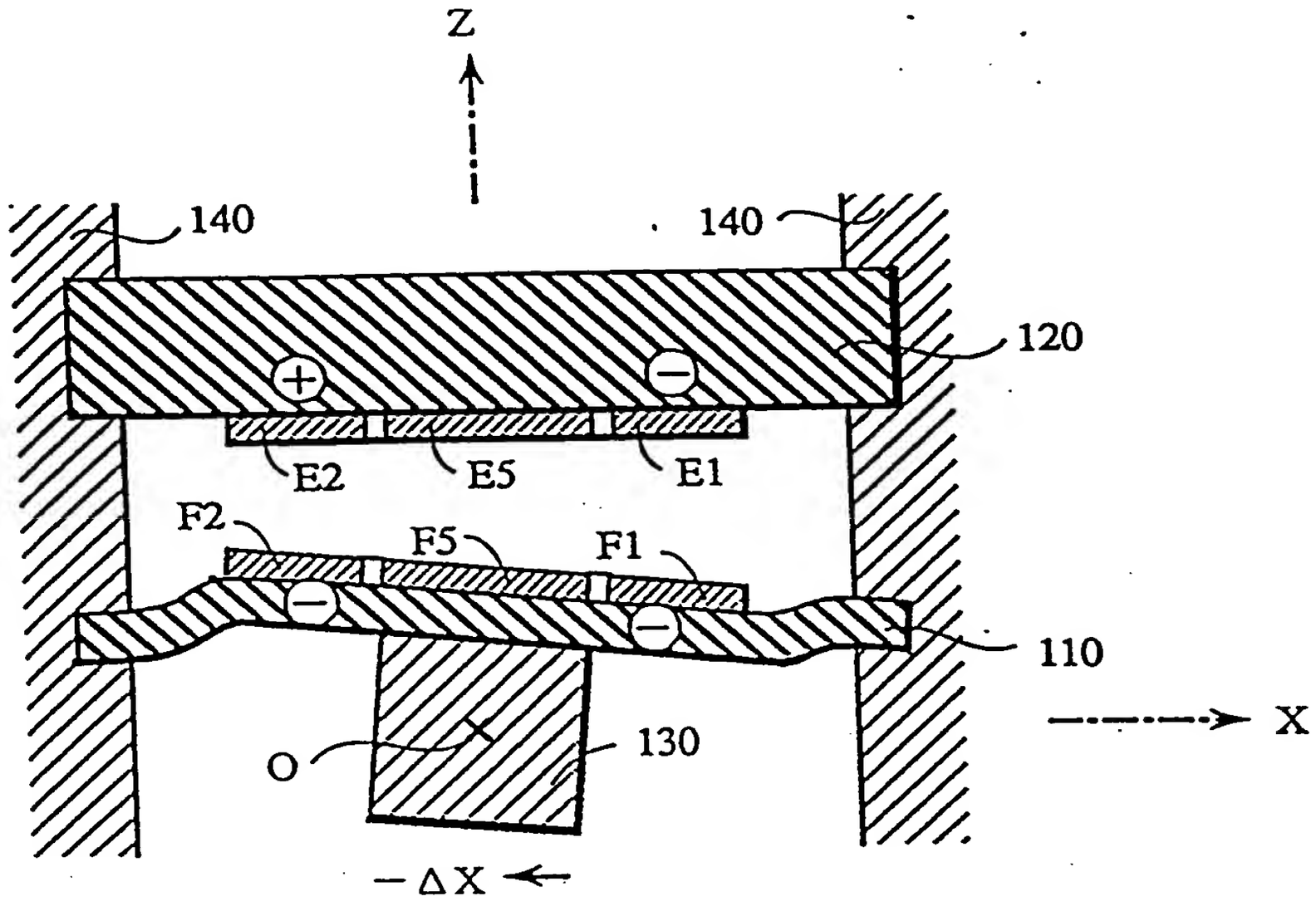

Z
140
140
120
E2
E5
E1
F2
F5
F1
110
X
O
130
−ΔX

Fig.24

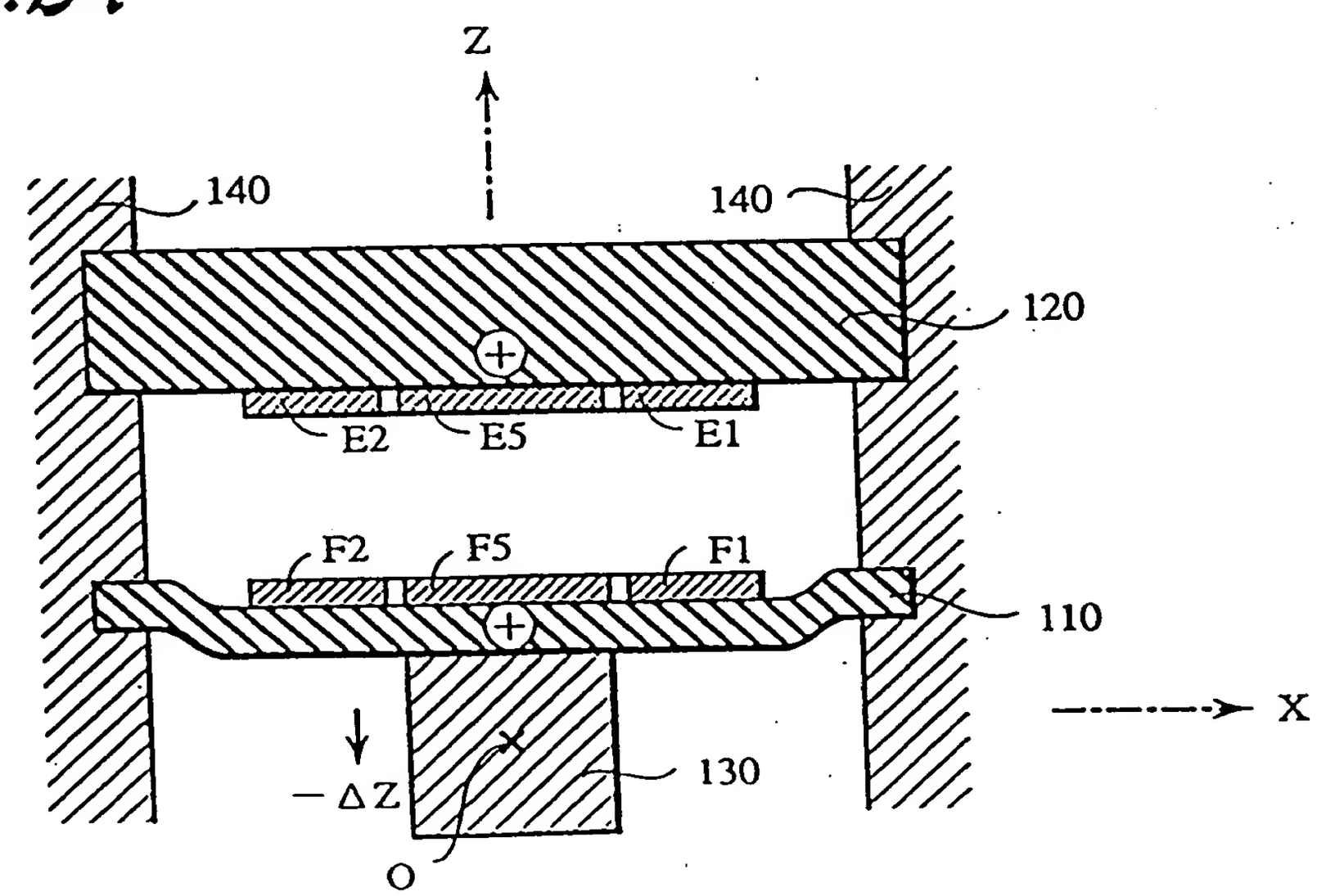

Z
140
140
120
E2
E5
E1
F2
F5
F1
110
X
130
−ΔZ
O

Fig.25

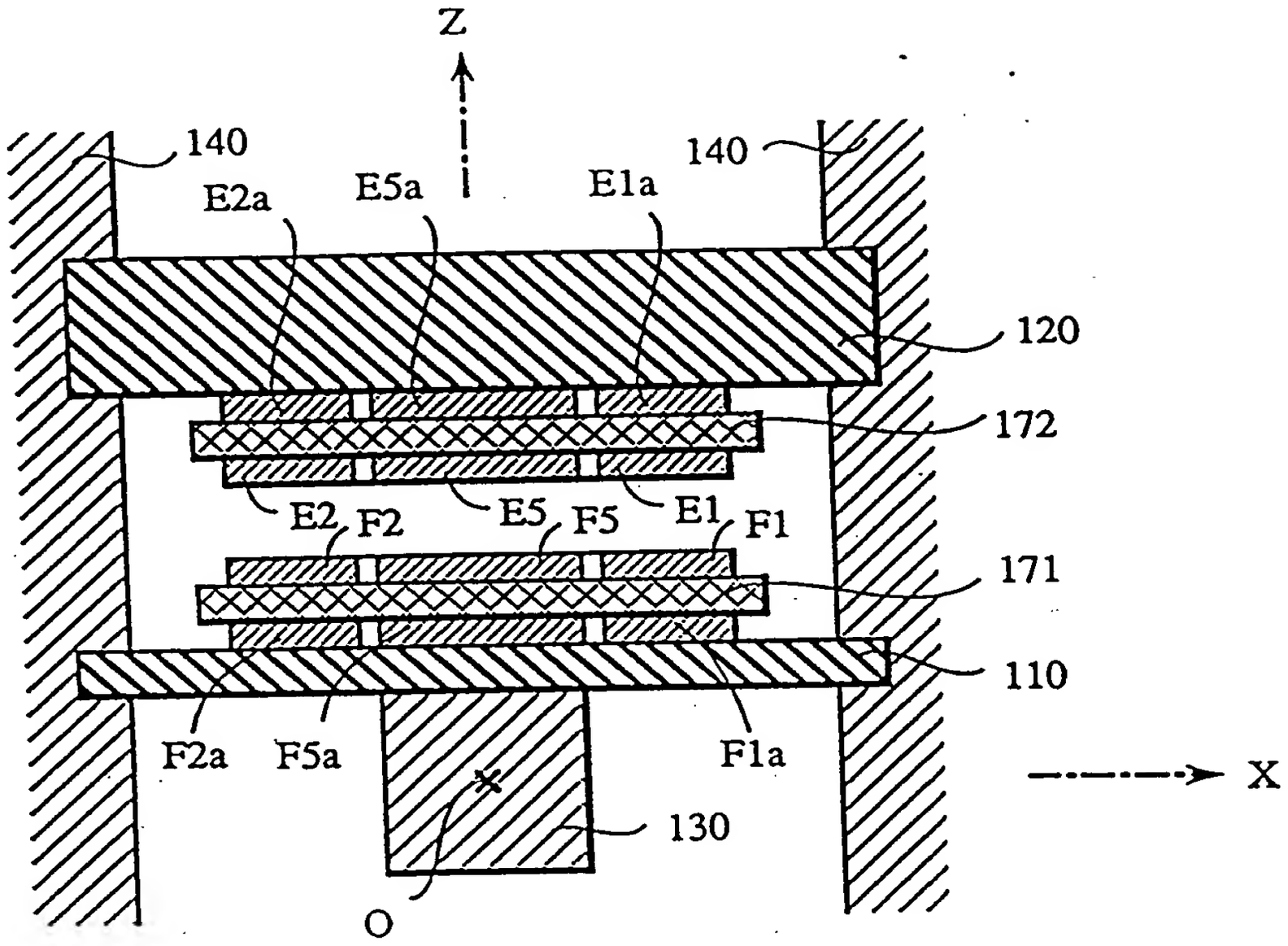

Z
140
E2a
E5a
E1a
140
120
172
E2
F2
E5
F5
E1
F1
171
110
F2a
F5a
F1a
X
130
O

Fig.26

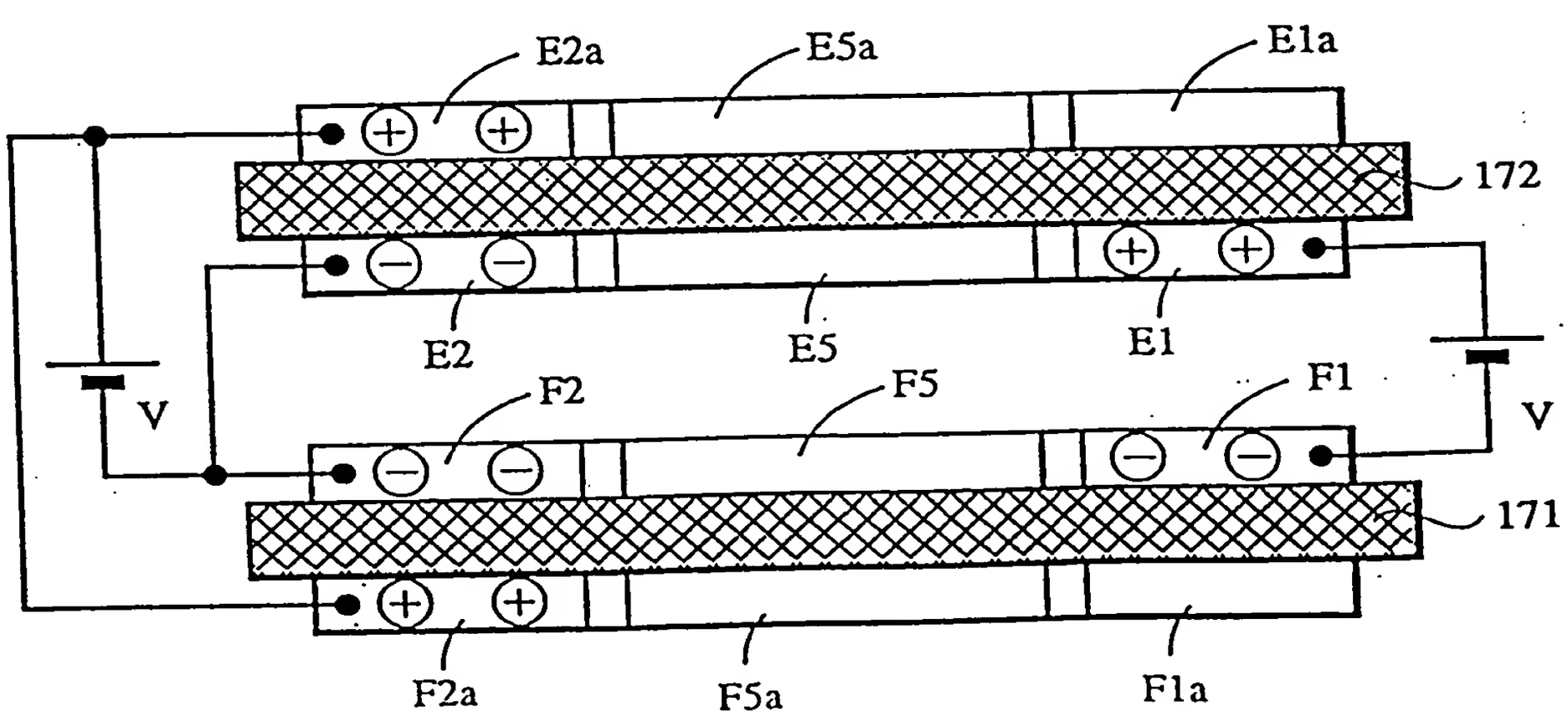

E2a
E5a
E1a
172
E2
E5
E1
V
F2
F5
F1
V
171
F2a
F5a
F1a

Fig.27

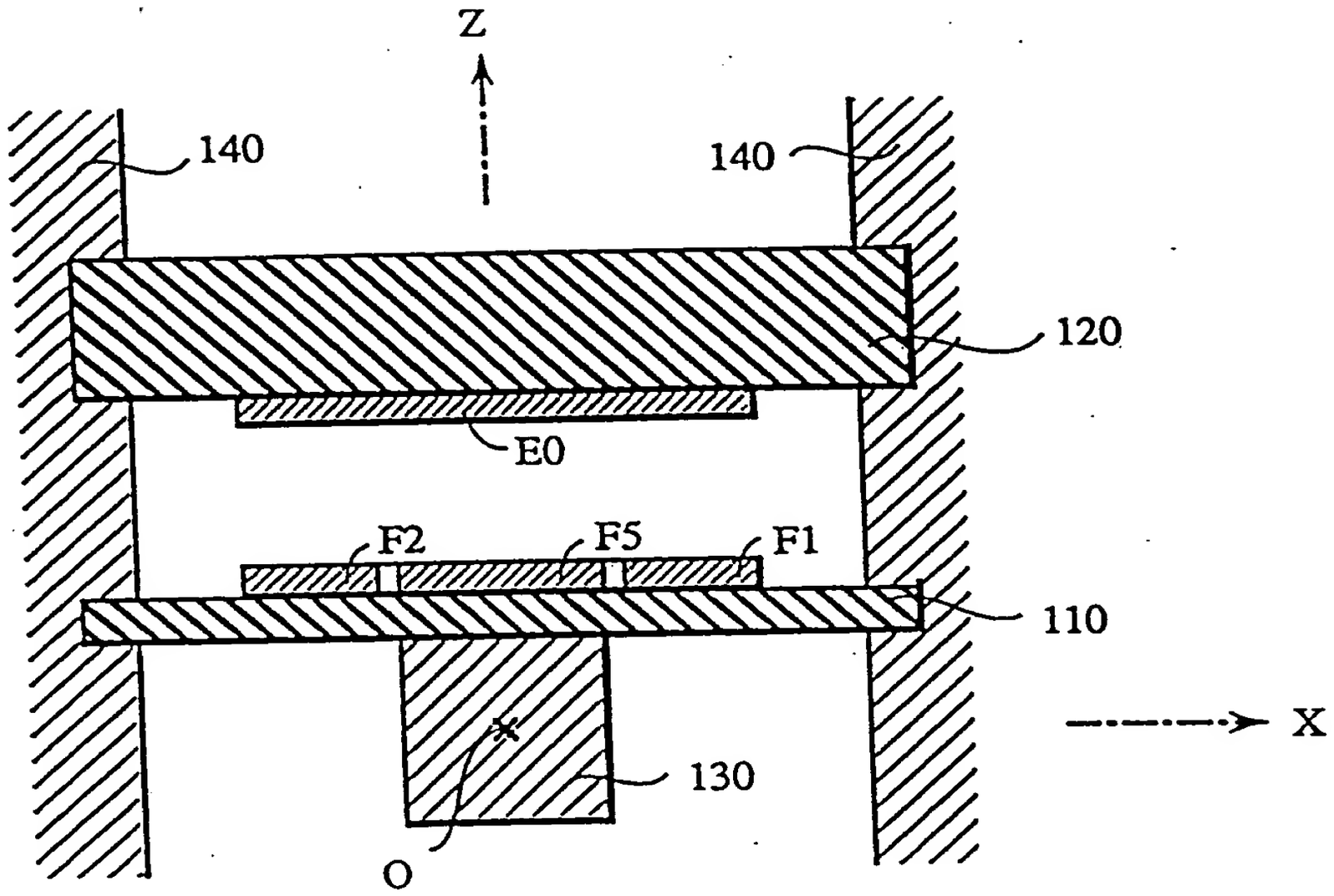

Z
140
140
120
E0
F2
F5
F1
110
X
130
O

Fig.28

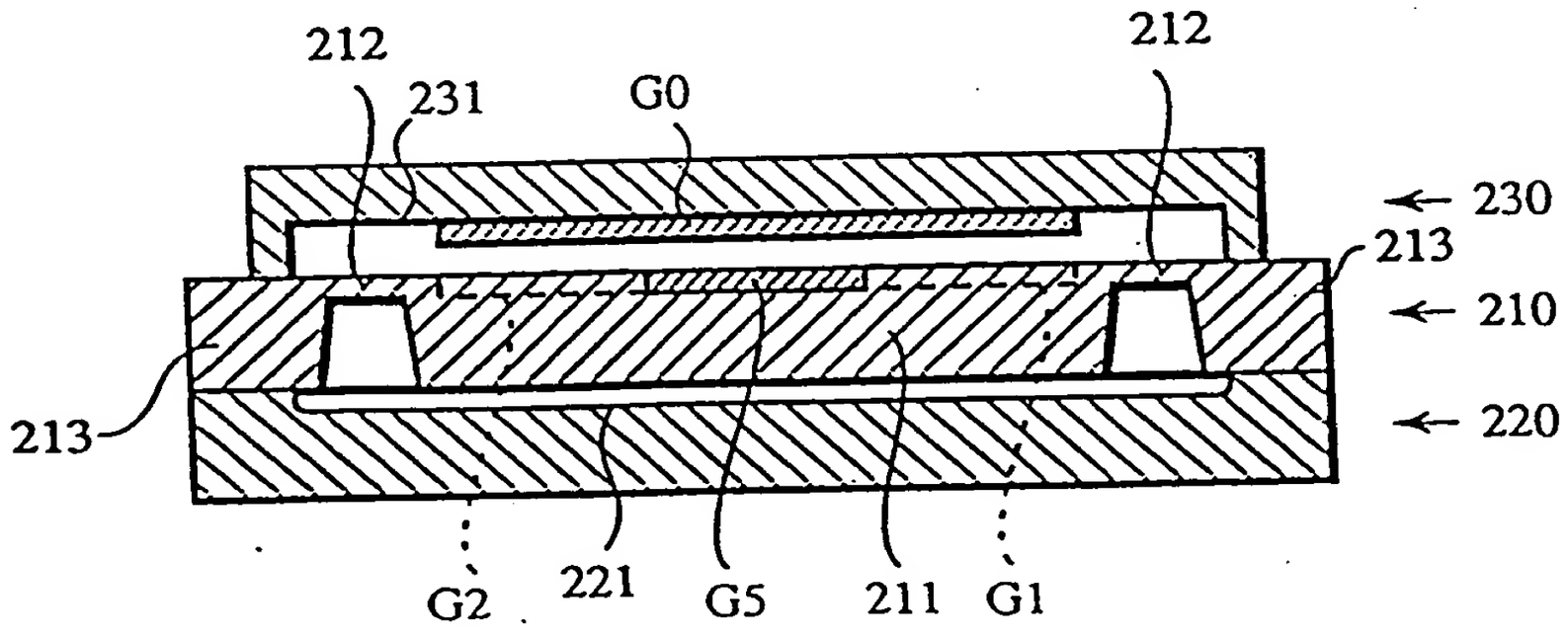

212
231
G0
212
230
213
210
213
220
G2
221
G5
211
G1

Fig.29

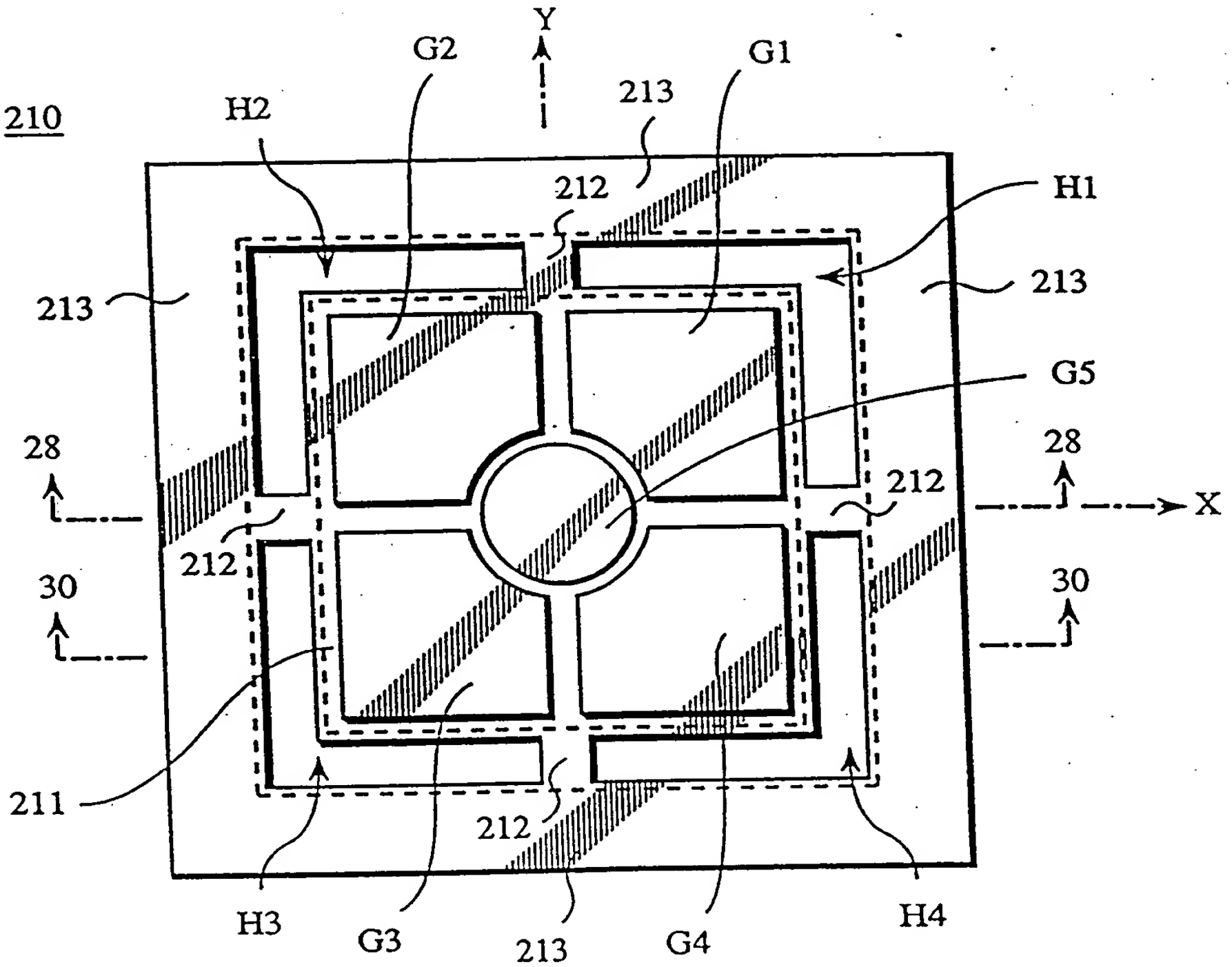

210
H2
G2
Y
G1
213
212
H1
213
213
G5
28
28
212
X
212
30
30
211
212
H3
G3
213
G4
H4

Fig.30

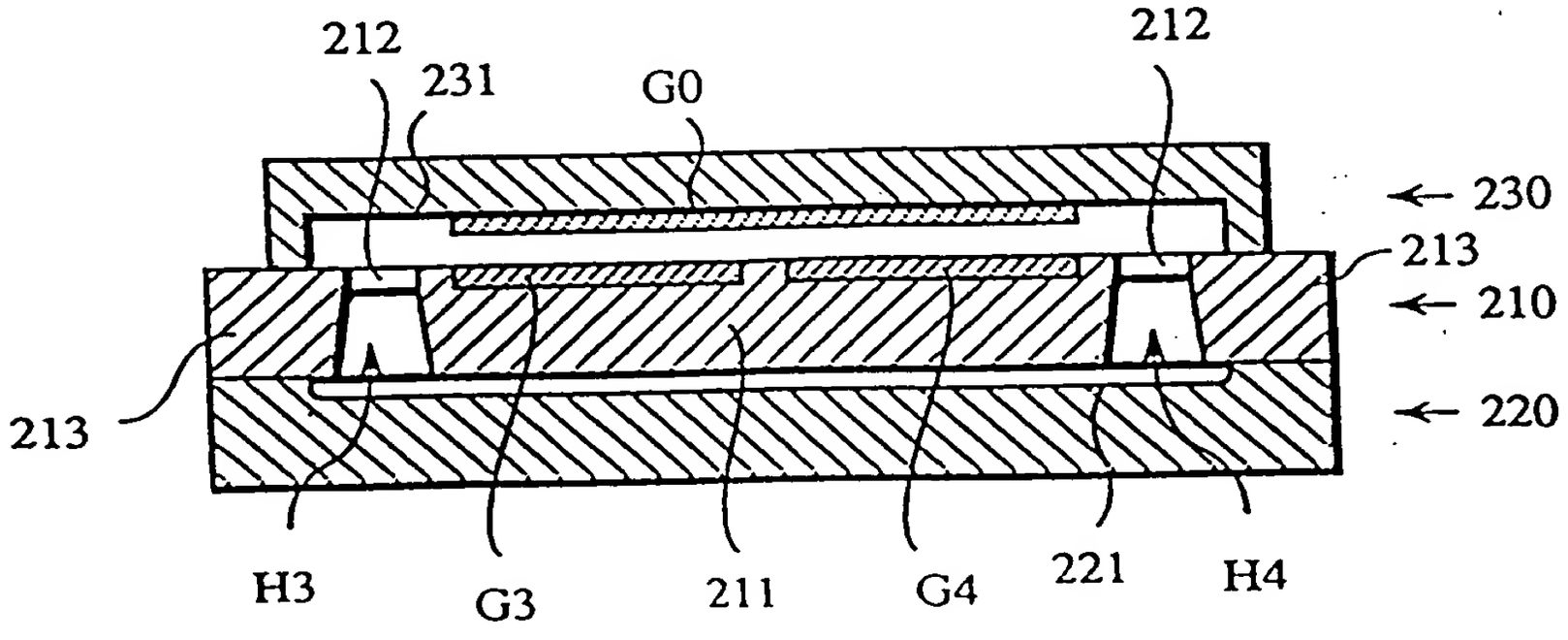

212
231
G0
212
230
213
210
213
220
H3
G3
211
G4
221
H4

Fig.31

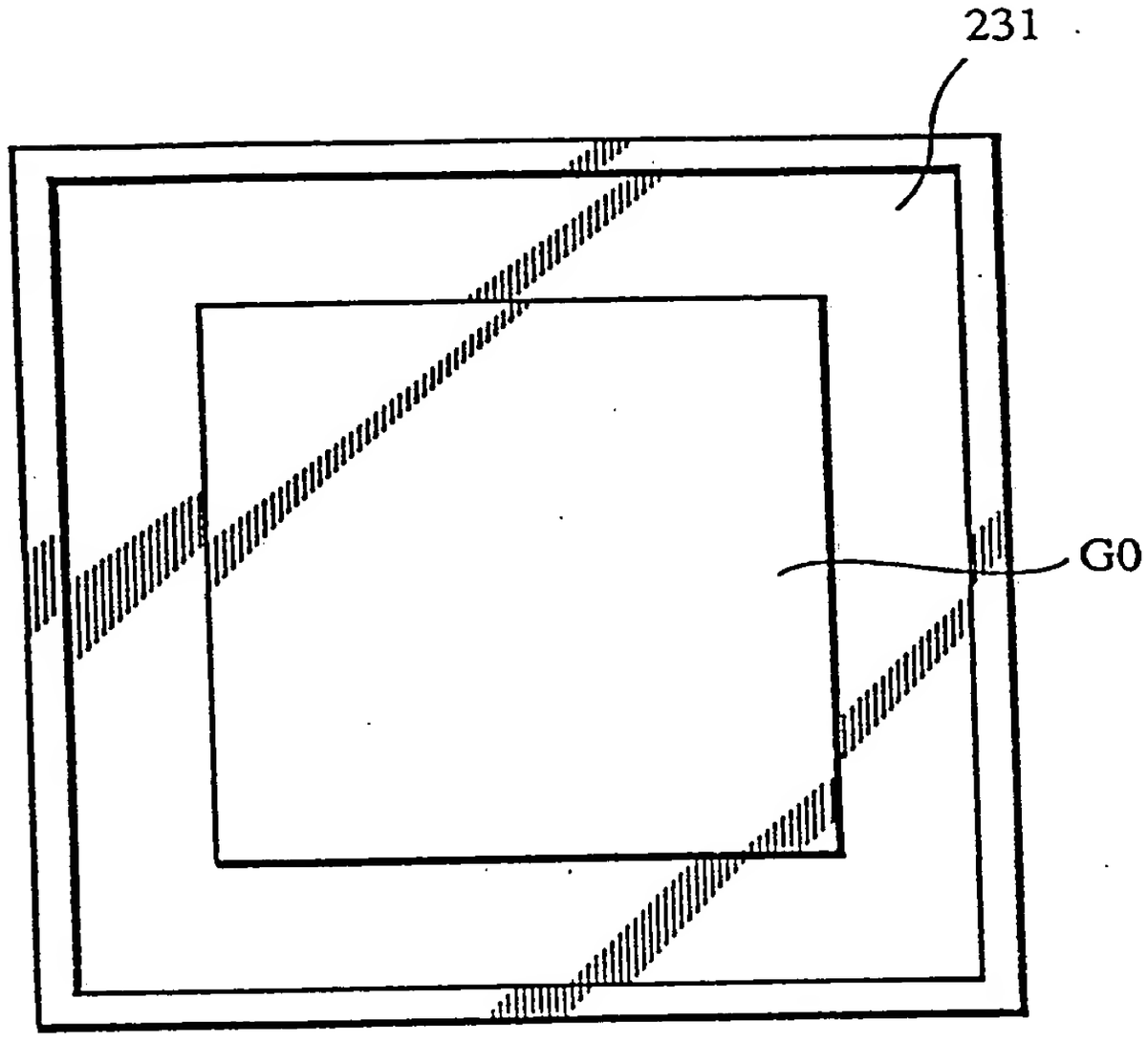

230
231
G0

Fig.32

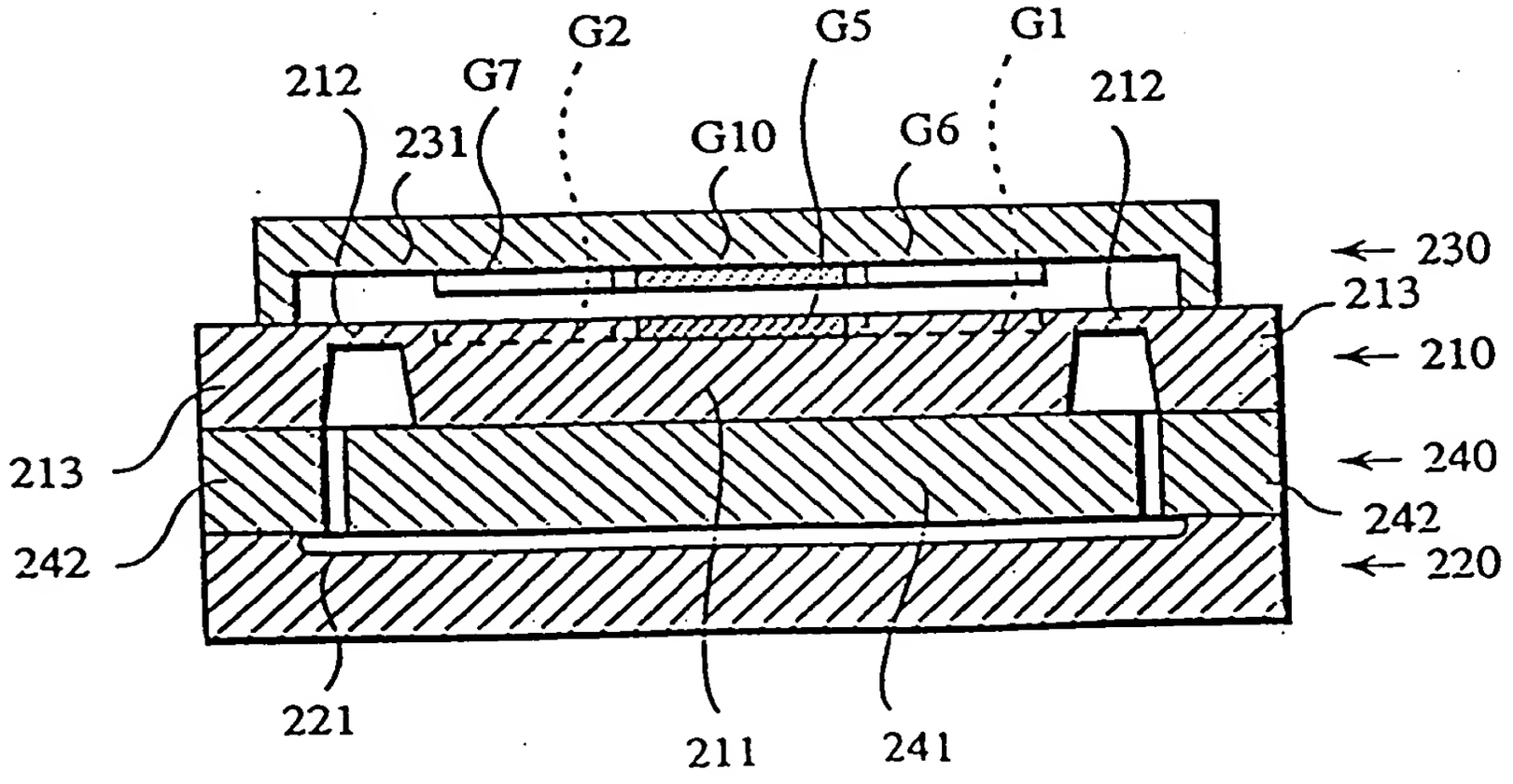

G2
G5
G1
212
G7
231
G10
G6
212
230
213
210
213
240
242
242
220
221
211
241

Fig.33

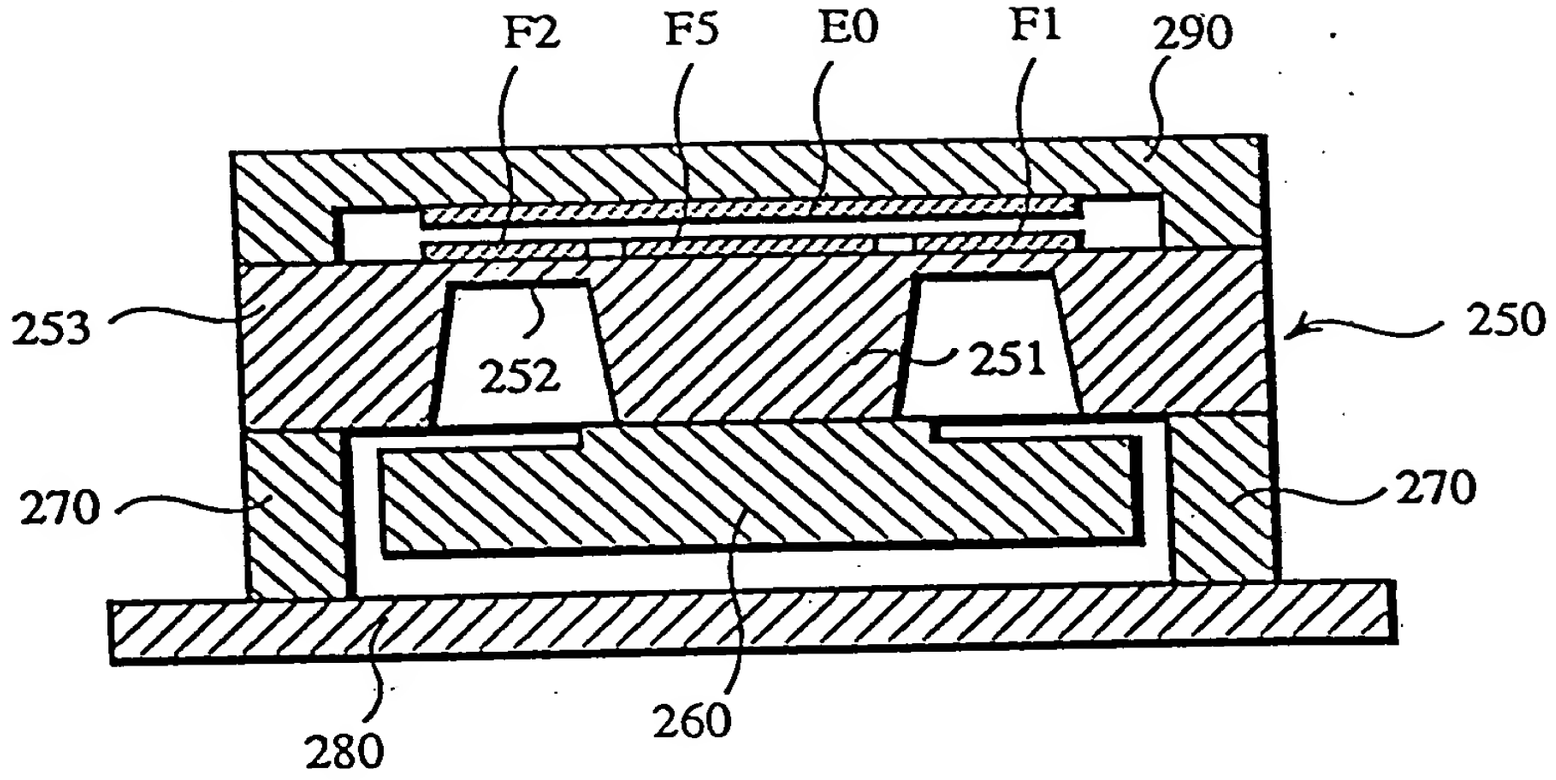

F2
F5
E0
F1
290
253
252
251
250
270
270
280
260

Fig.34

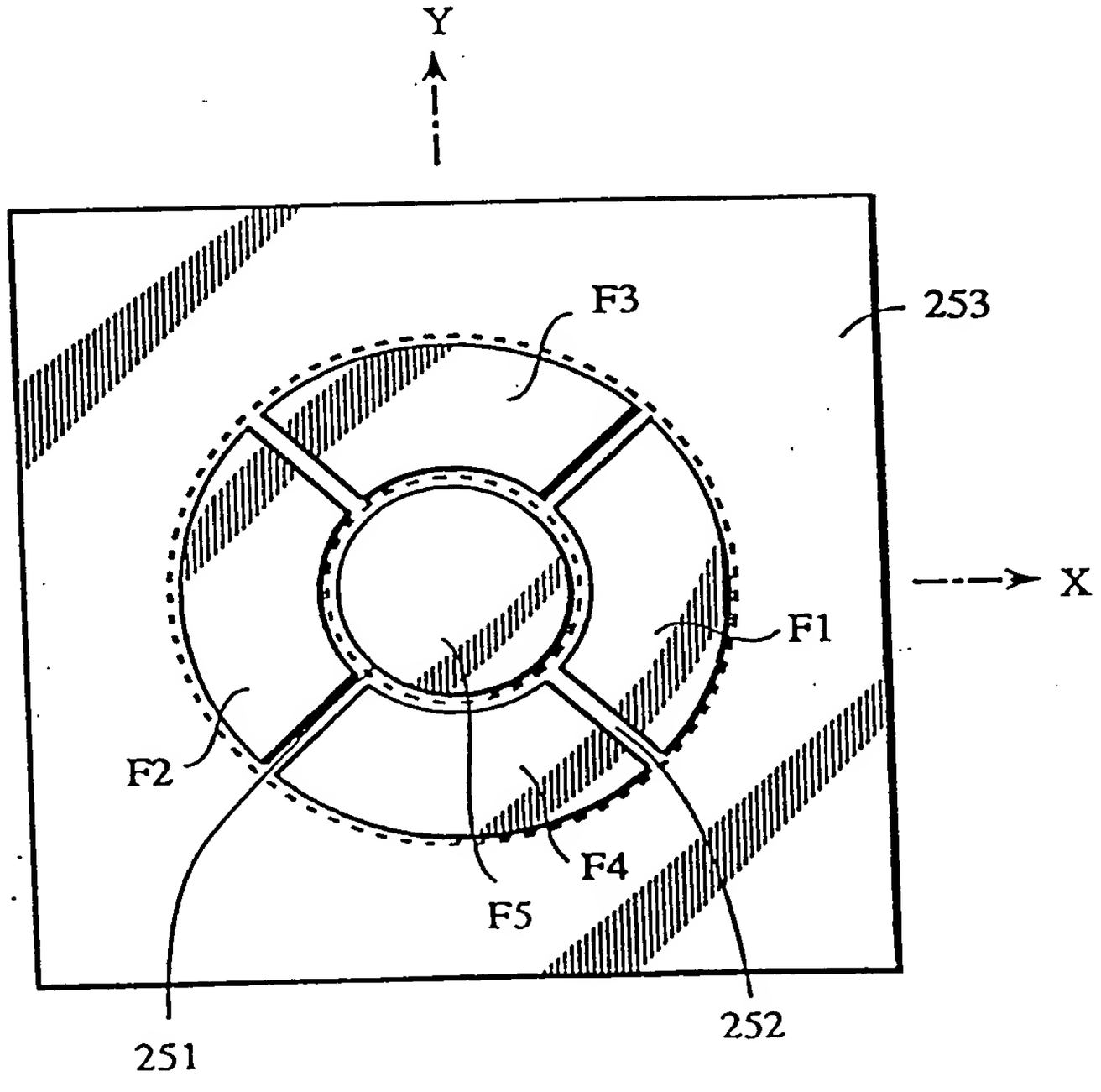

250
Y
F3
253
X
F1
F2
F4
F5
251
252

Fig.35

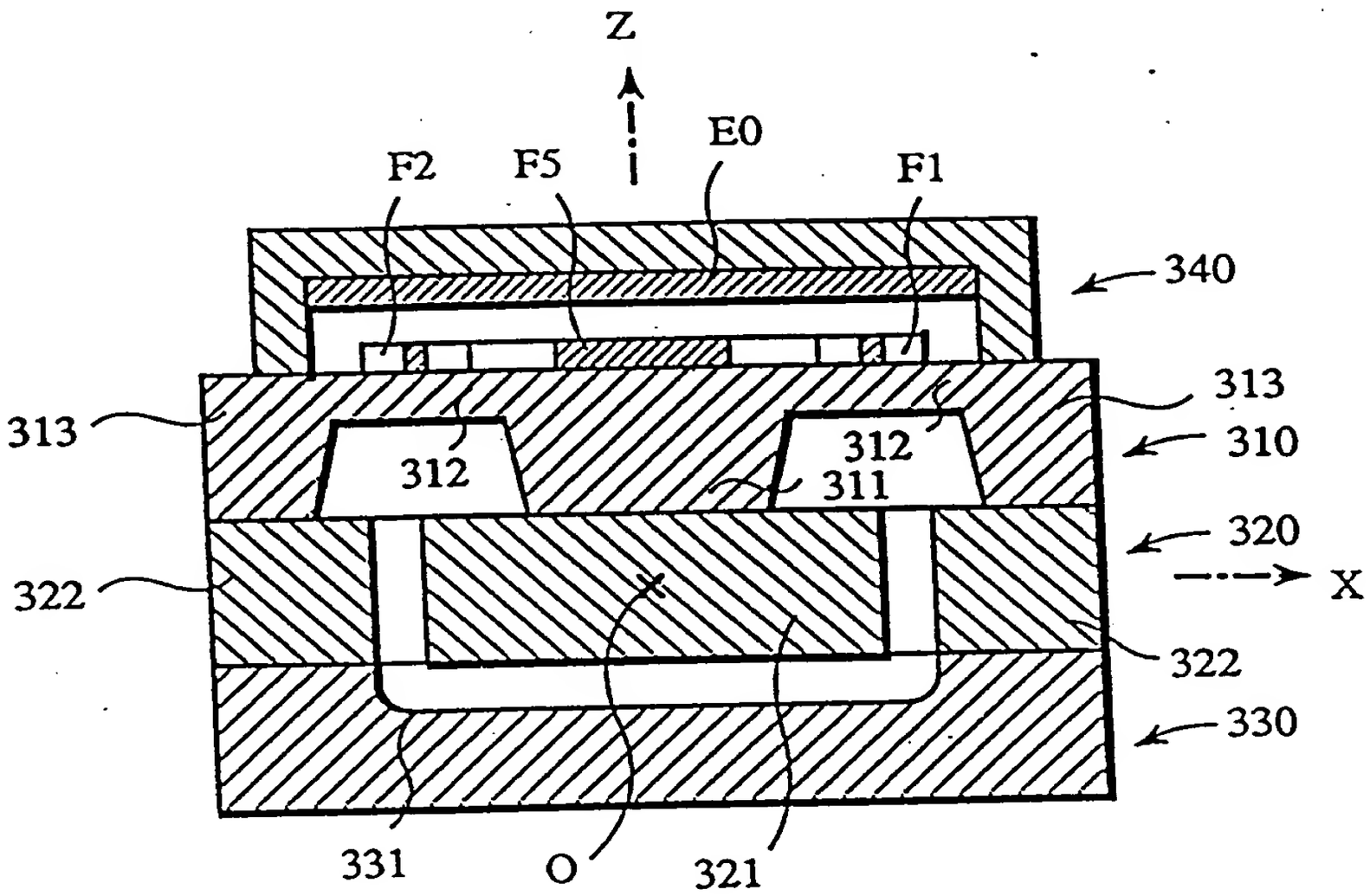

Z
F2
F5
E0
F1
340
313
313
310
312
312
311
320
X
322
322
330
331
O
321

Fig.36

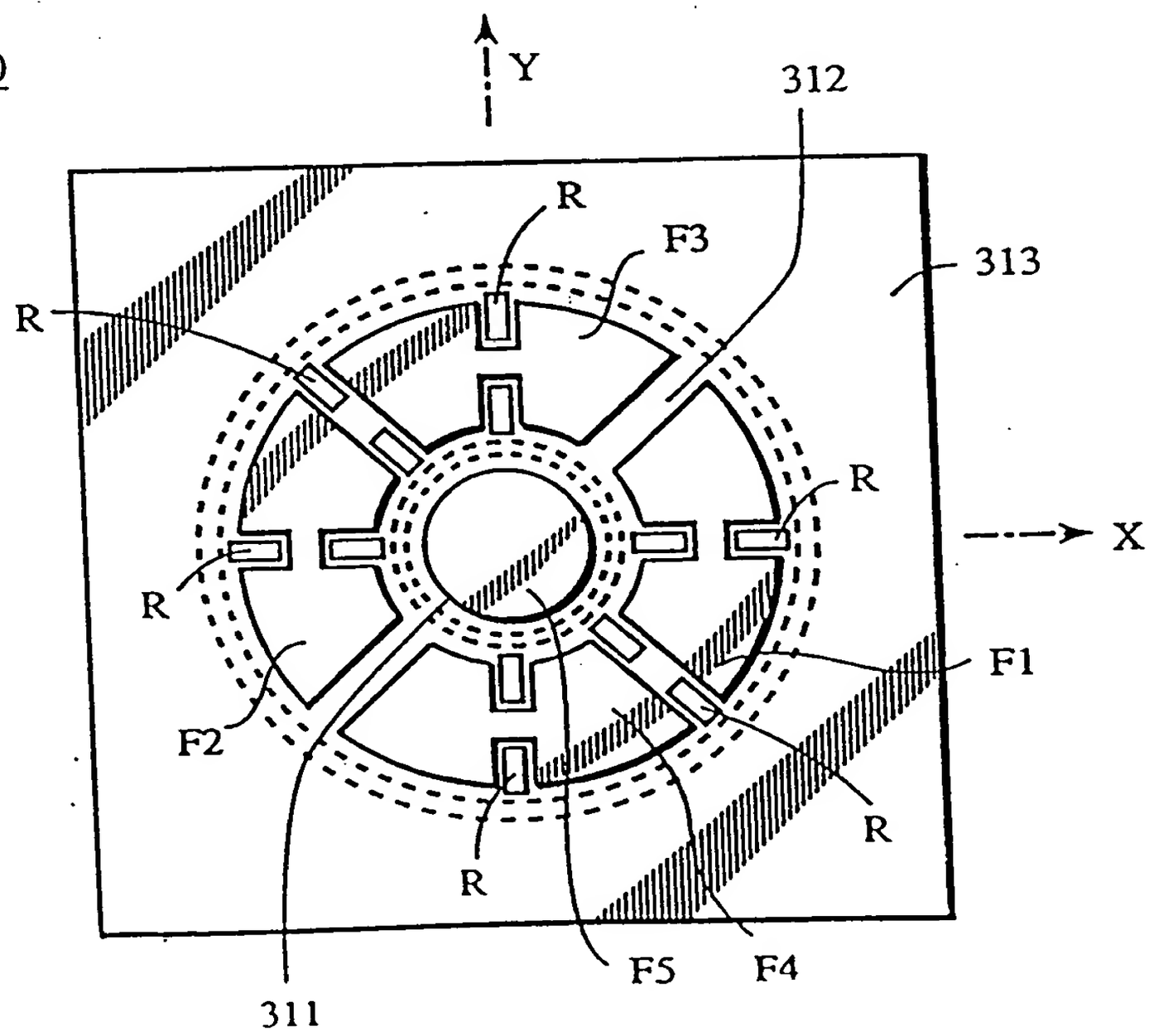

310
Y
312
313
R
R
F3
R
R
X
F1
F2
R
R
311
F5
F4

Fig.37

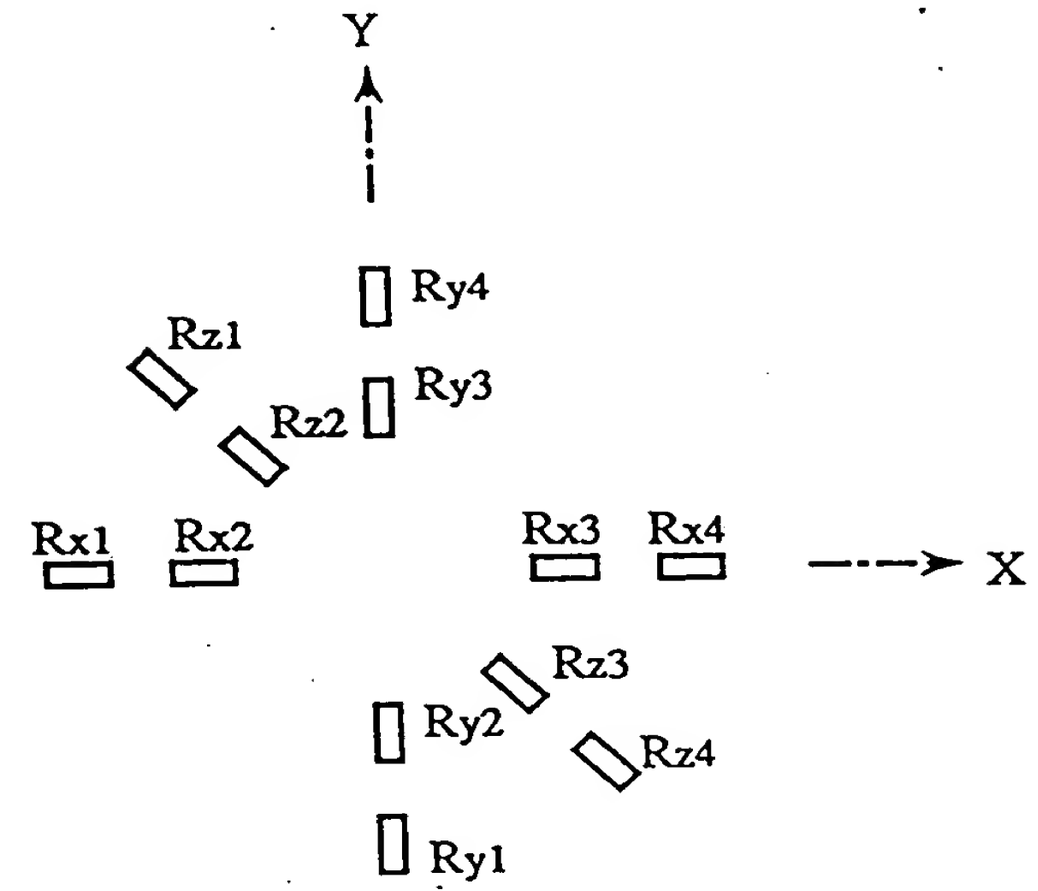

Y
Ry4
Rz1
Ry3
Rz2
Rx1
Rx2
Rx3
Rx4
X
Rz3
Ry2
Rz4
Ry1

Fig.38

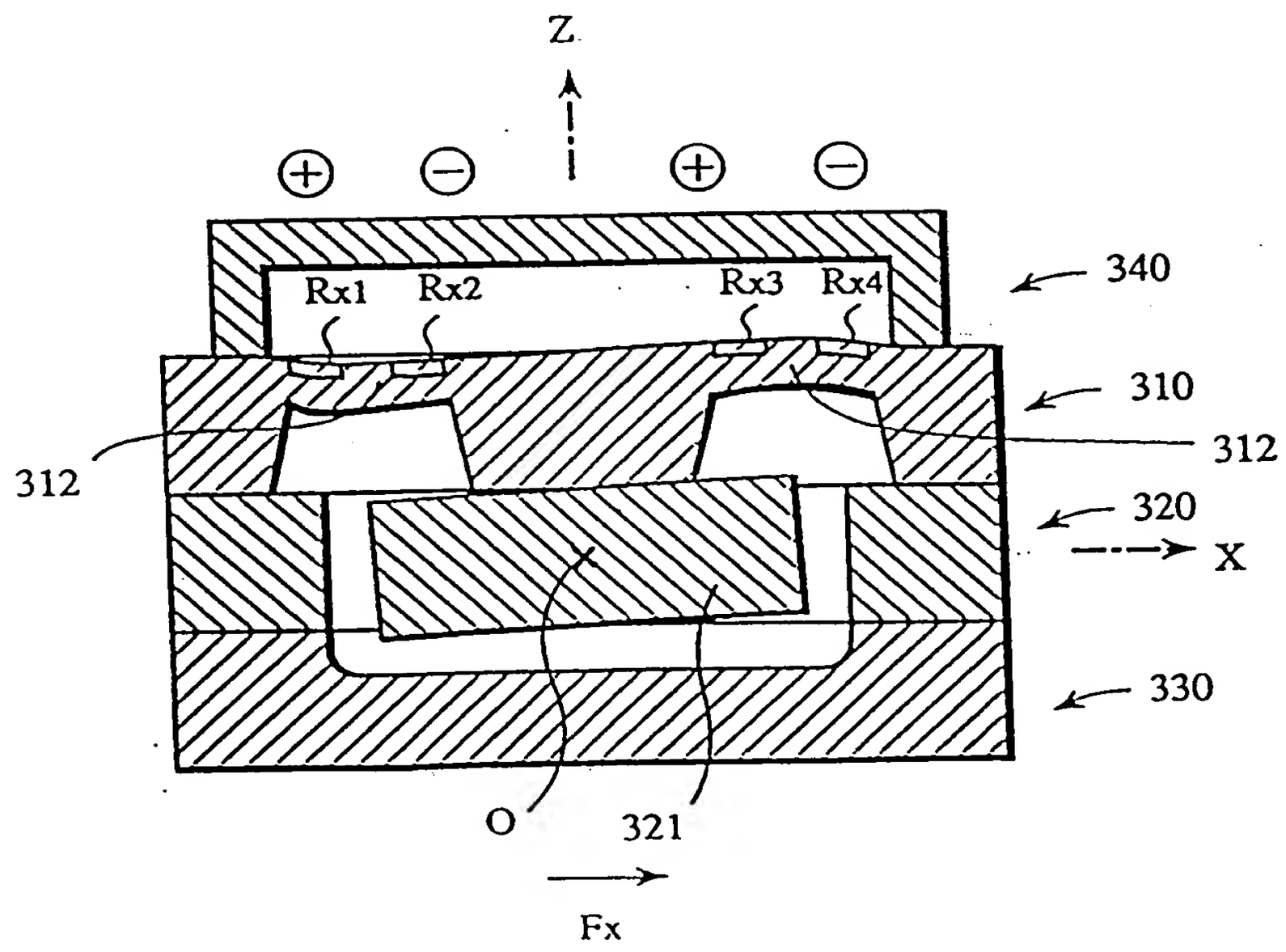

Z
⊕
⊖
⊕
⊖
Rx1
Rx2
Rx3
Rx4
340
310
312
312
320
X
330
O
321
Fx

Fig.39

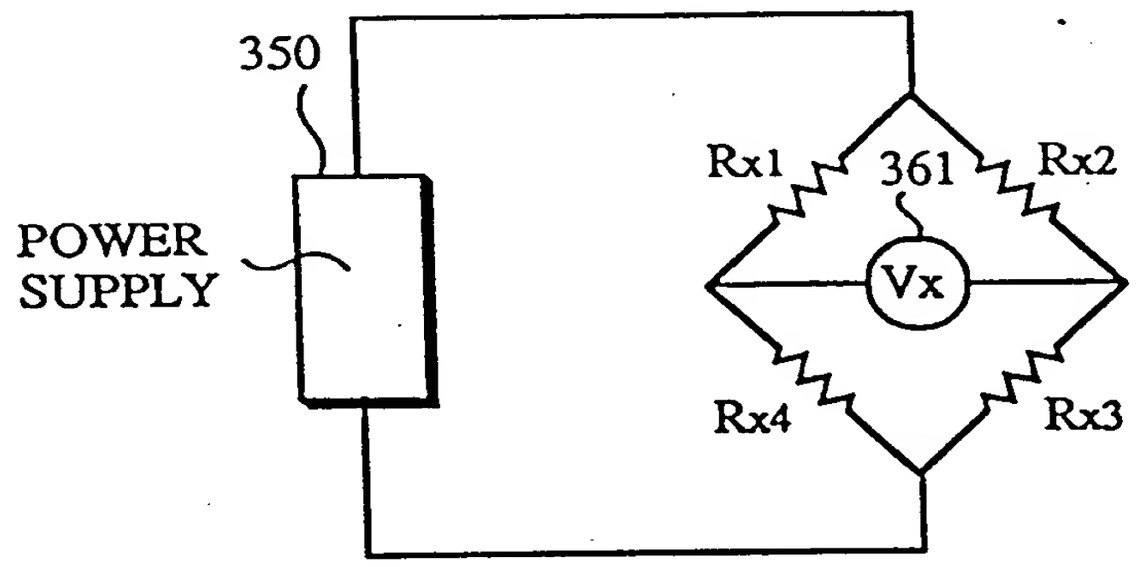


Fig.40

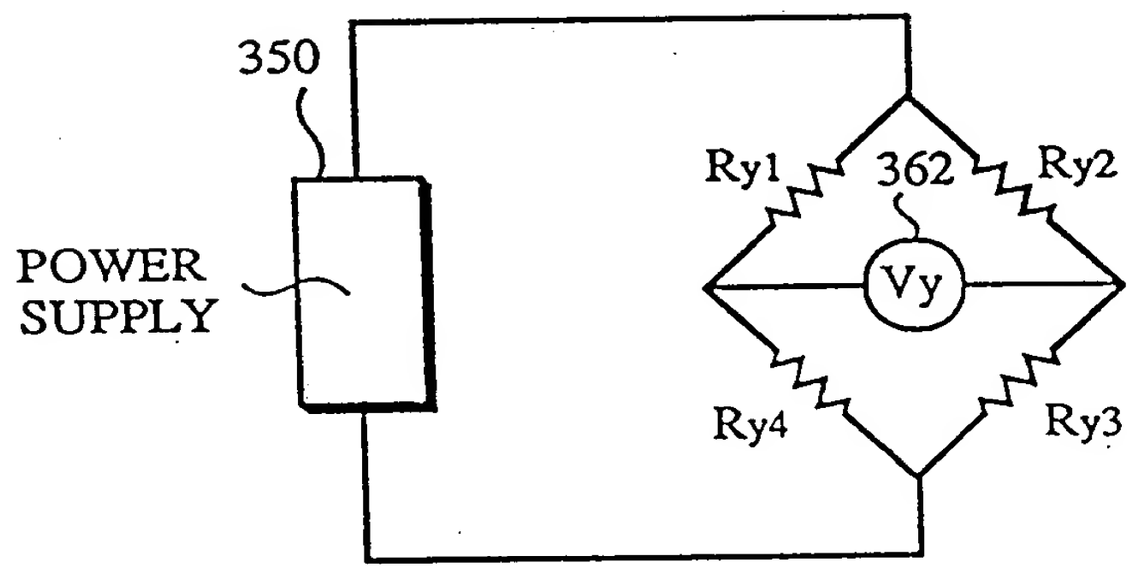


Fig.41

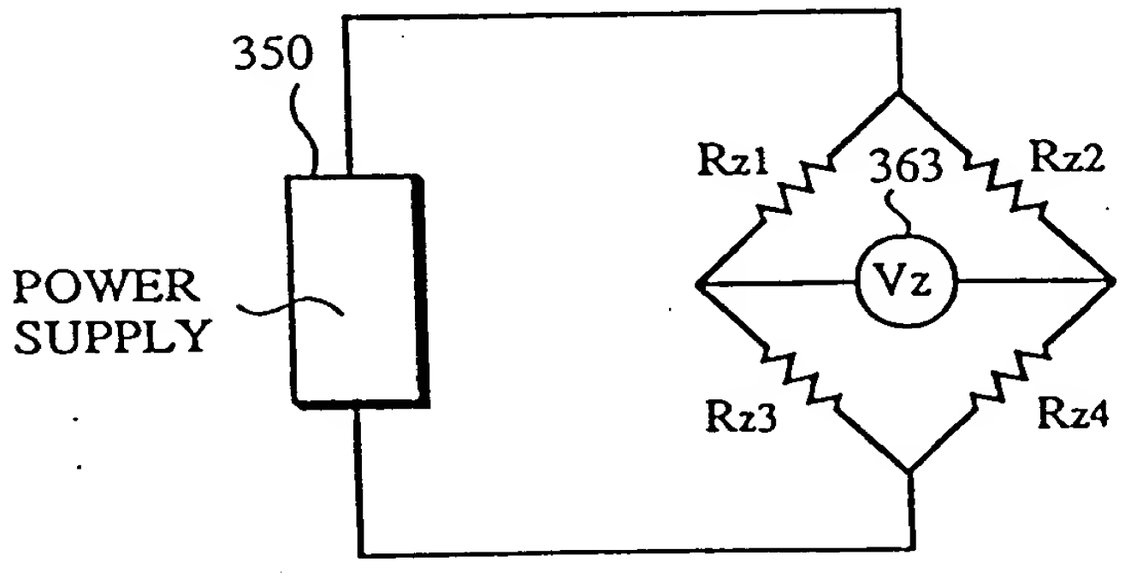


Fig.42

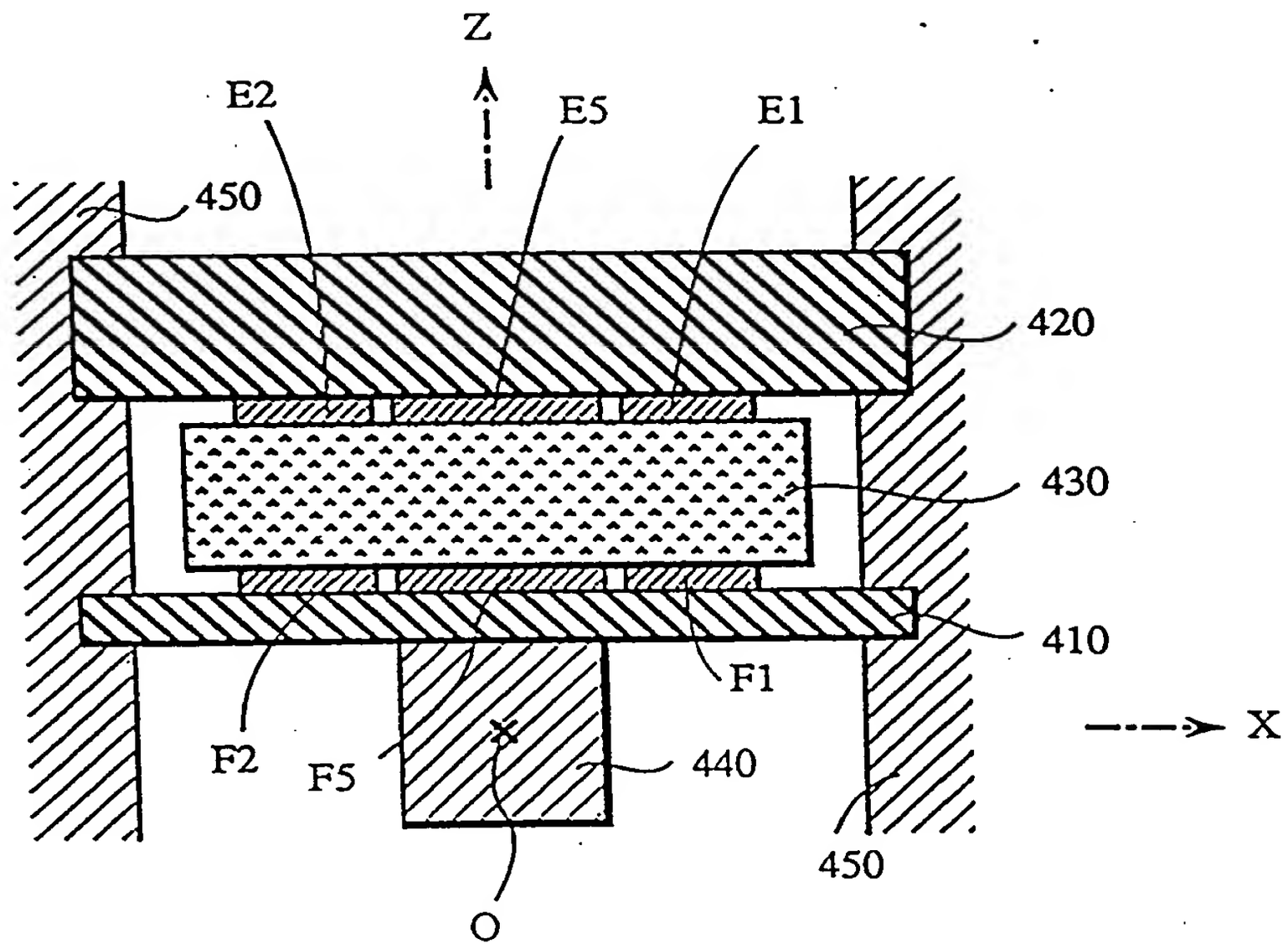


Fig.43a

TYPE I

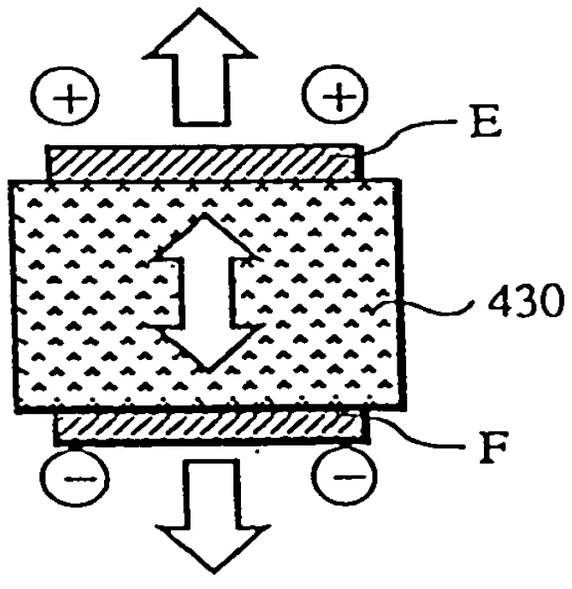


Fig.43b

TYPE I

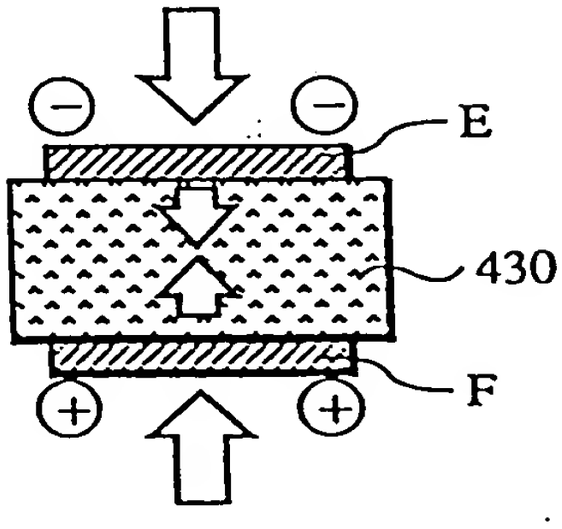


Fig.44

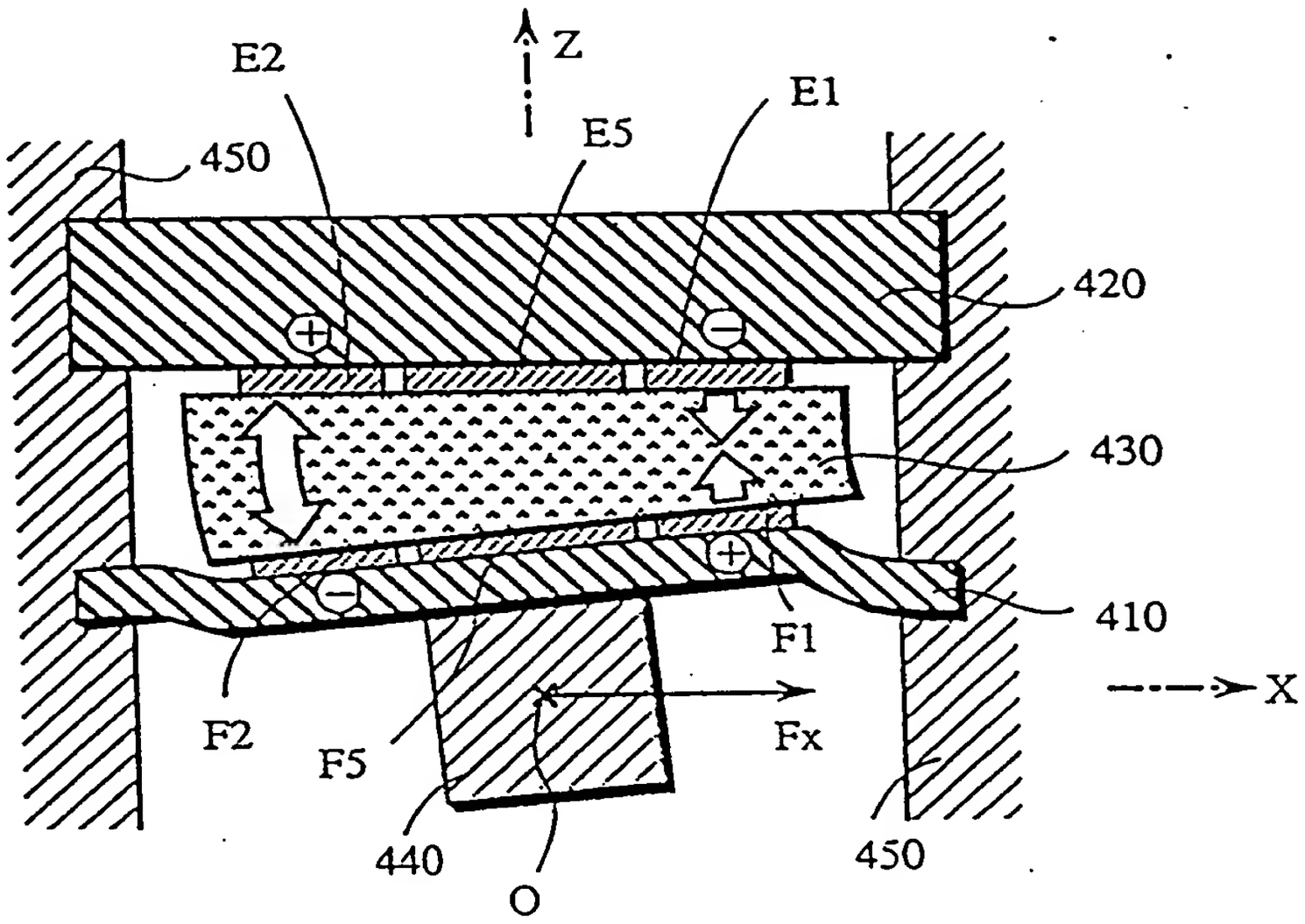
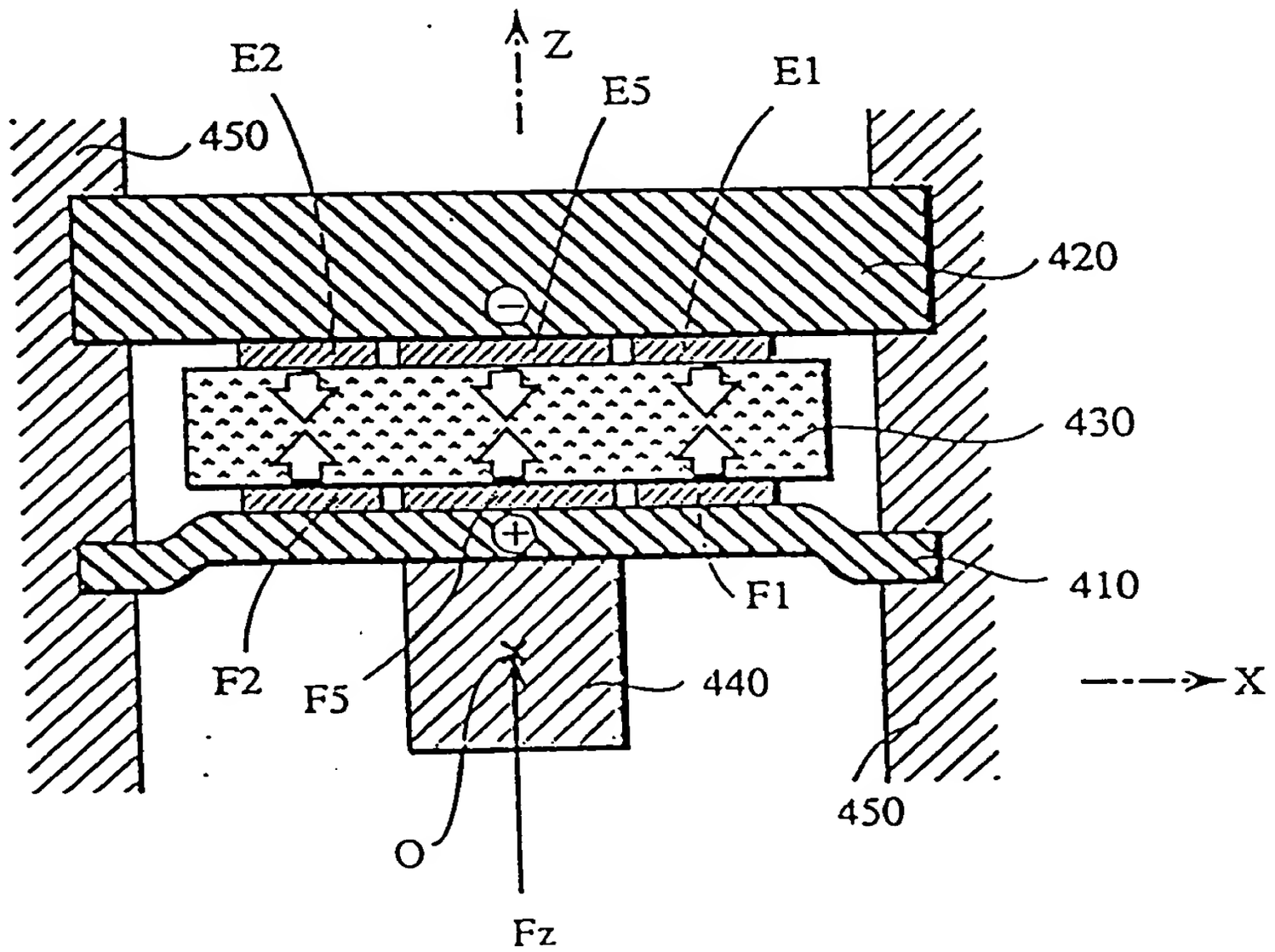

Z
E2
E5
E1
450
420
430
410
F1
X
F2
F5
Fx
440
O
450

Fig.45


Z
E2
E5
E1
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420
430
410
F1
X
F2
F5
440
O
Fz
450

Fig.46

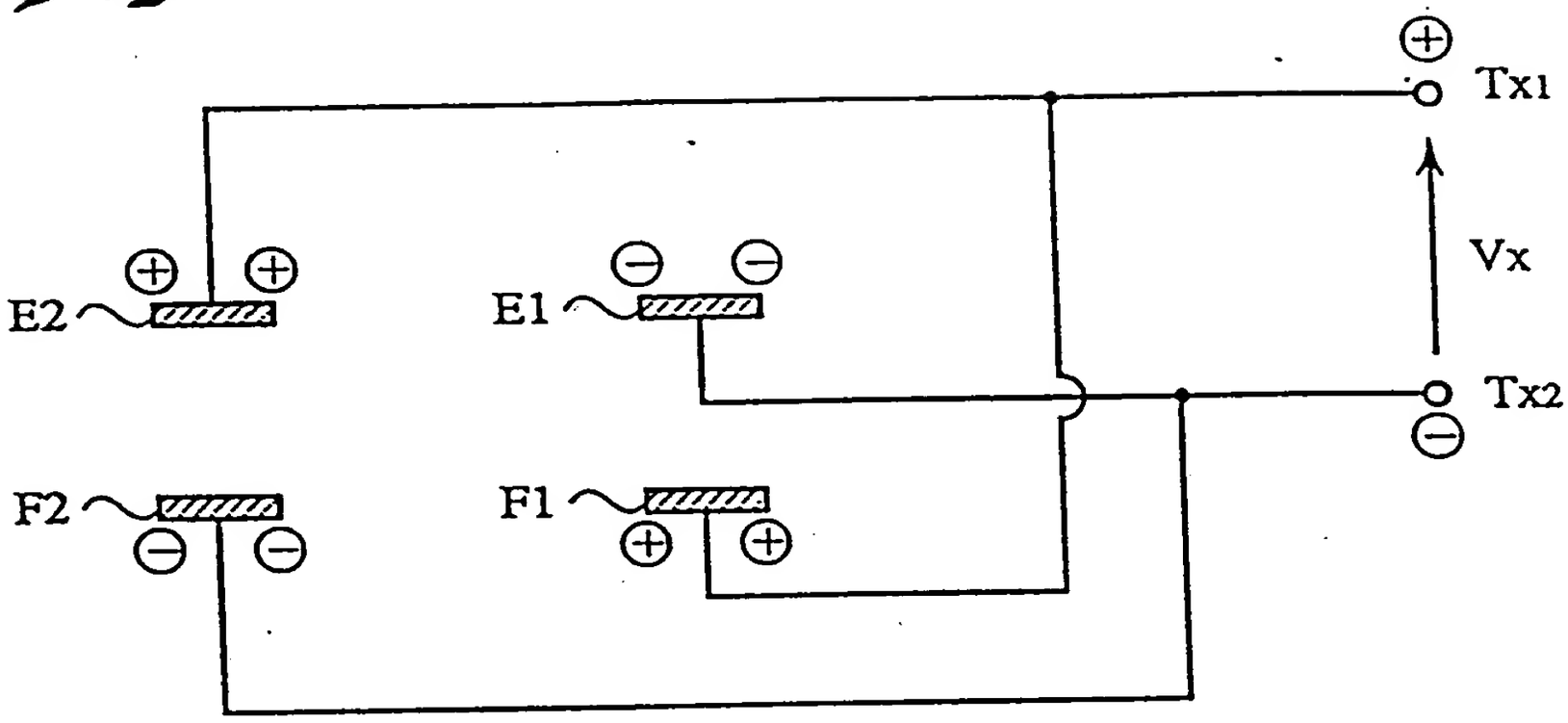

Fig.47

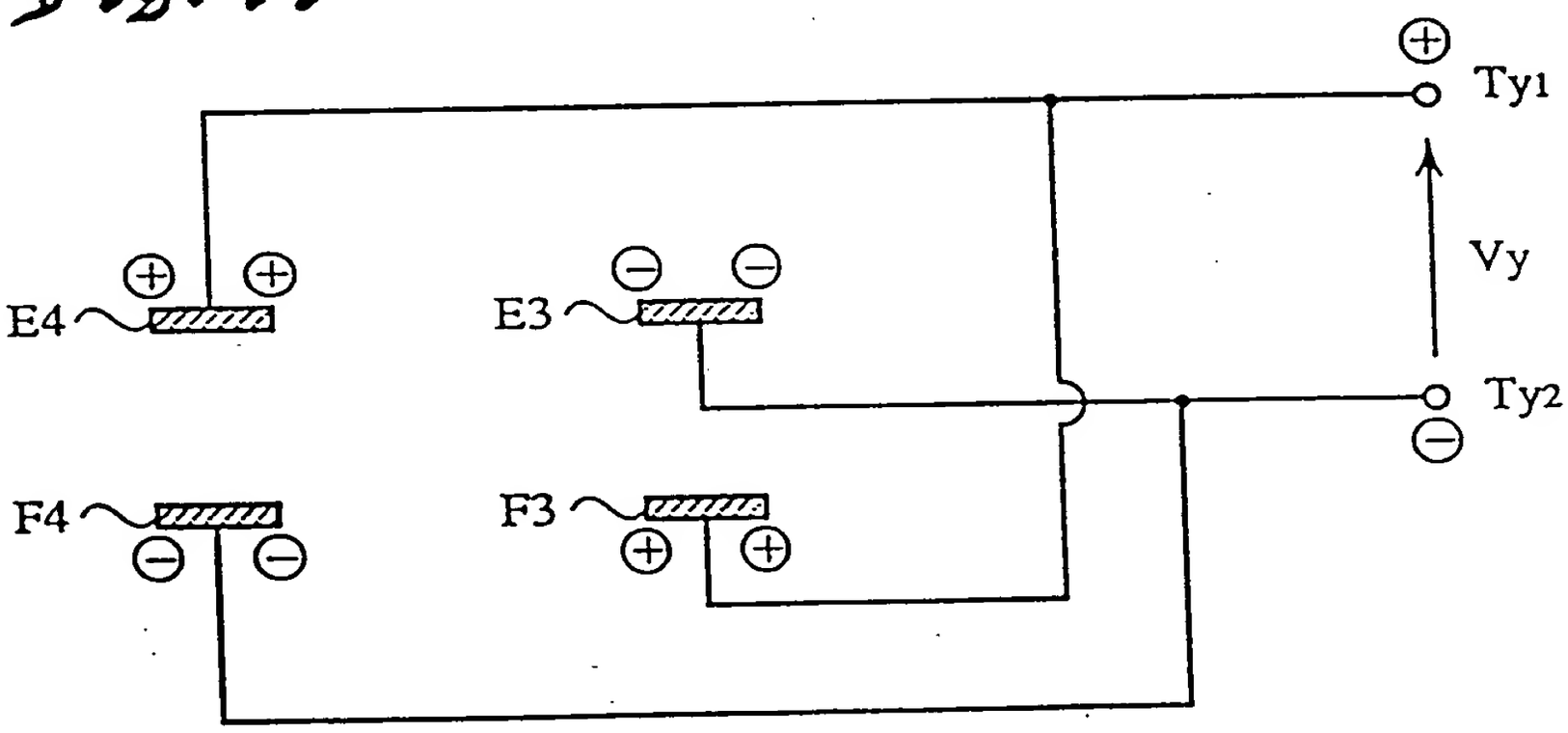

Fig.48

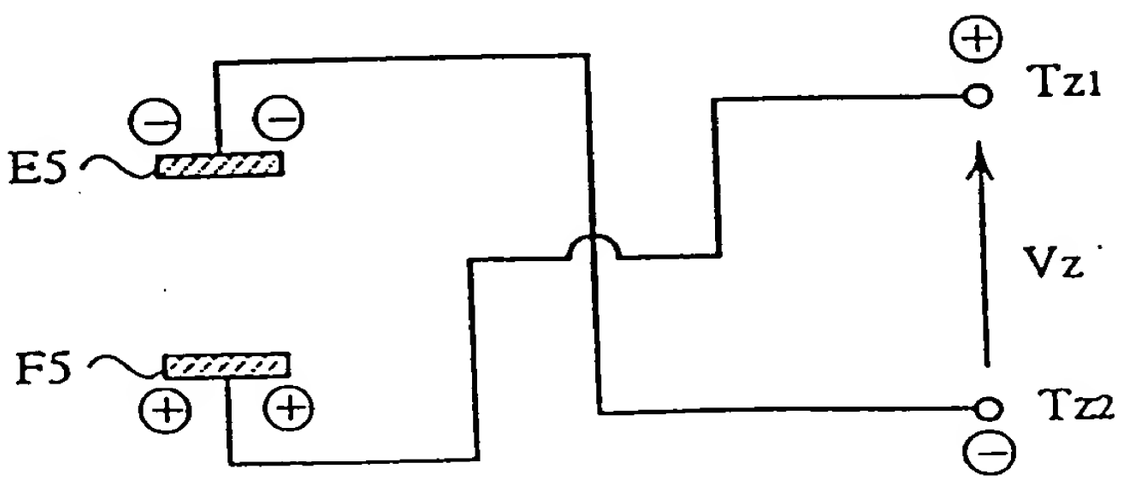

Fig.49a

TYPE II

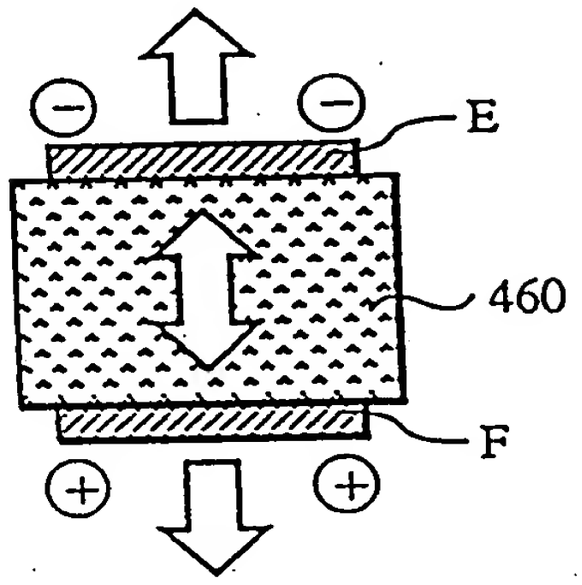

Fig.49b

TYPE II

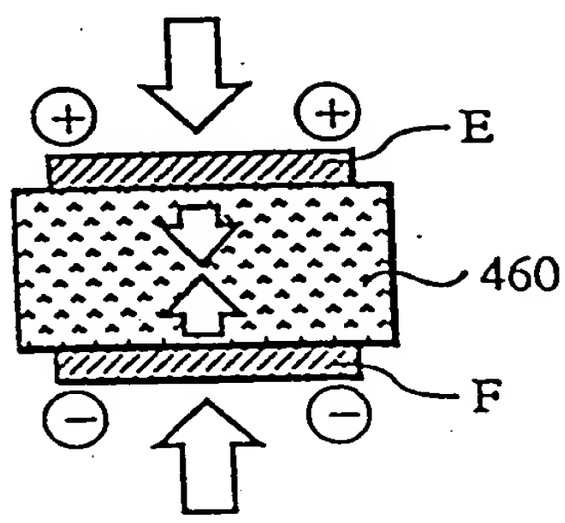

Fig.50

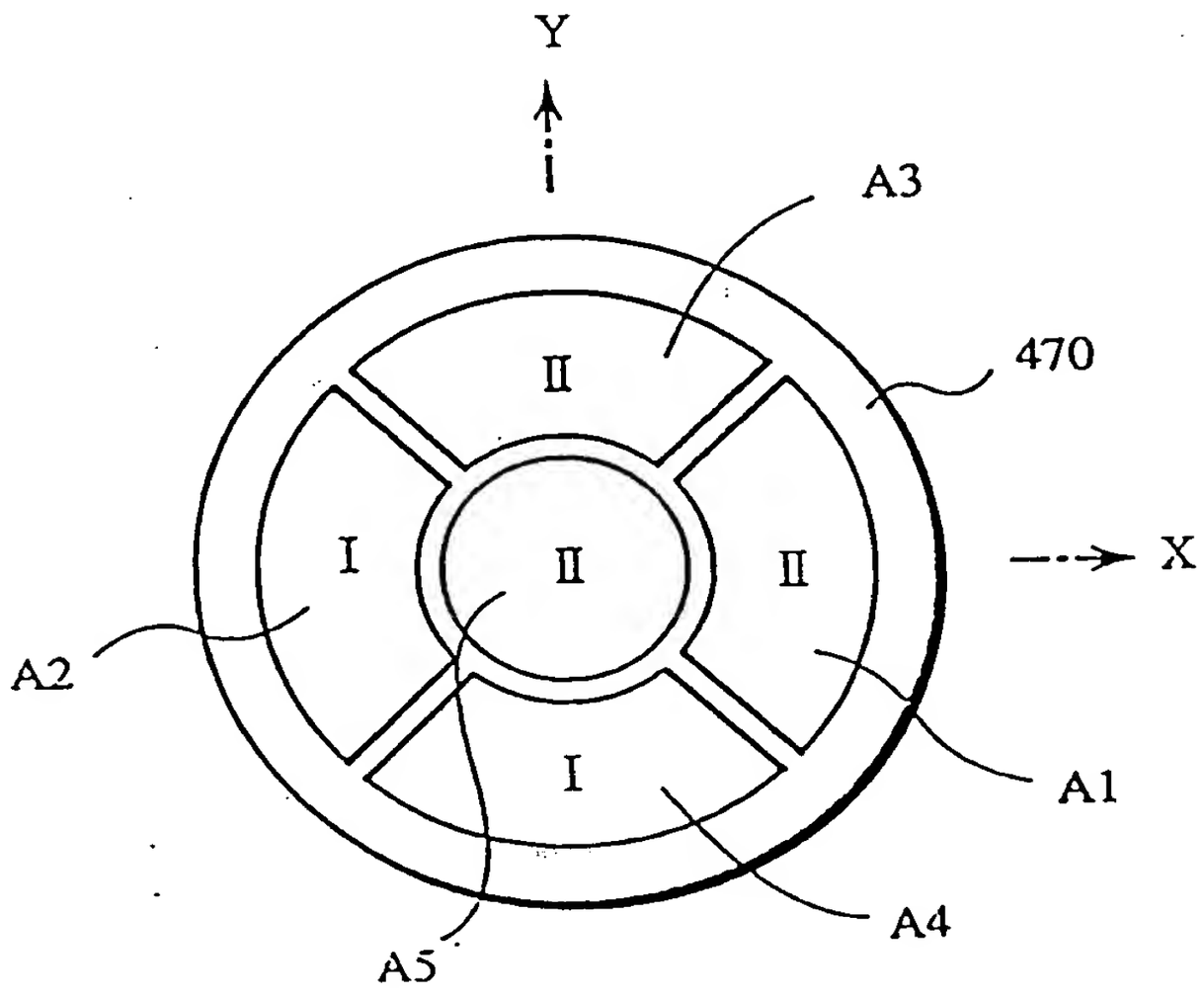

Fig.51

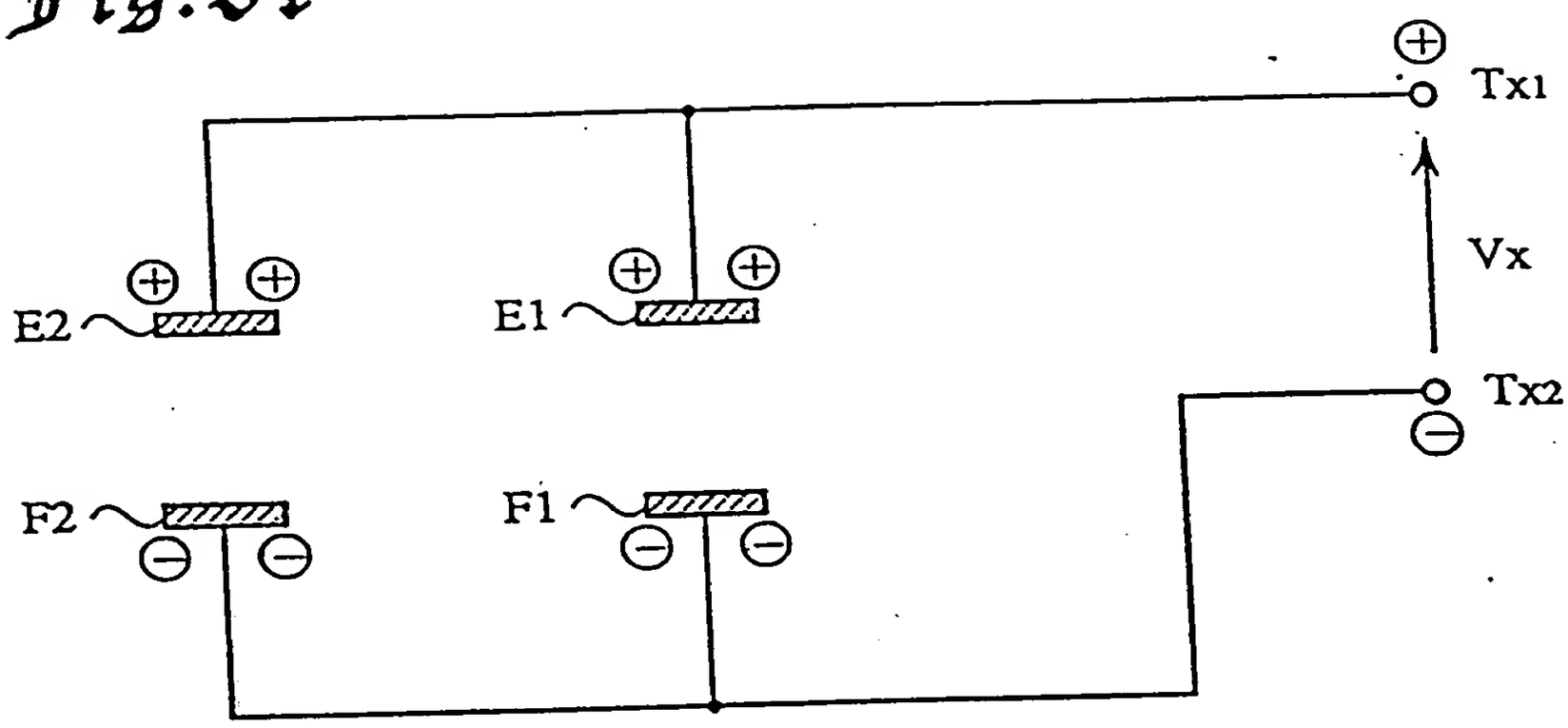

Fig.52

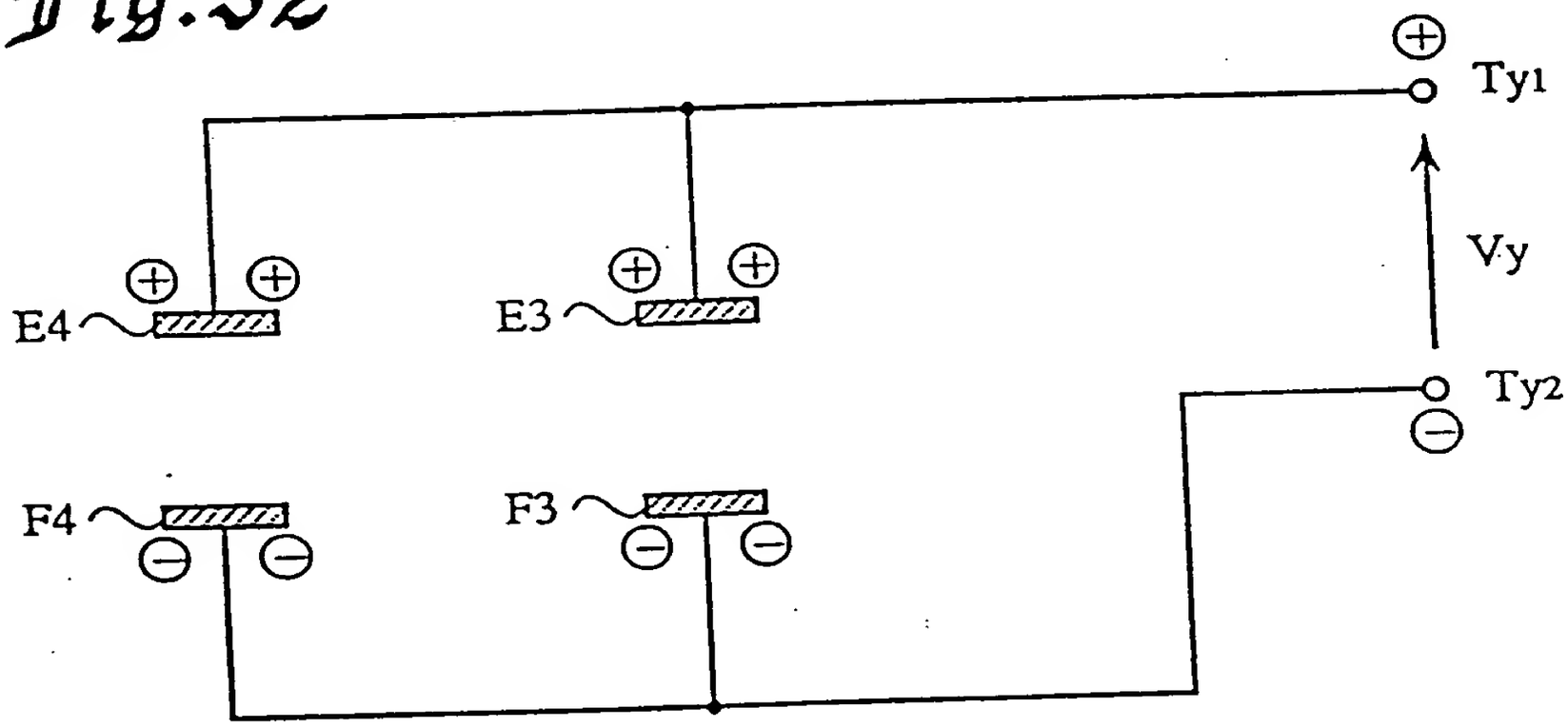

Fig.53

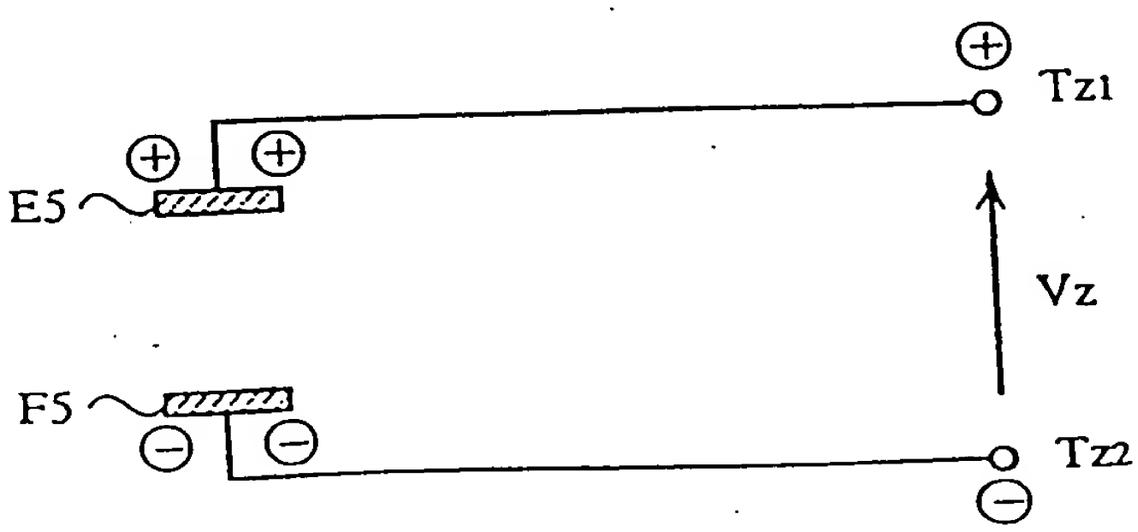

Fig.54

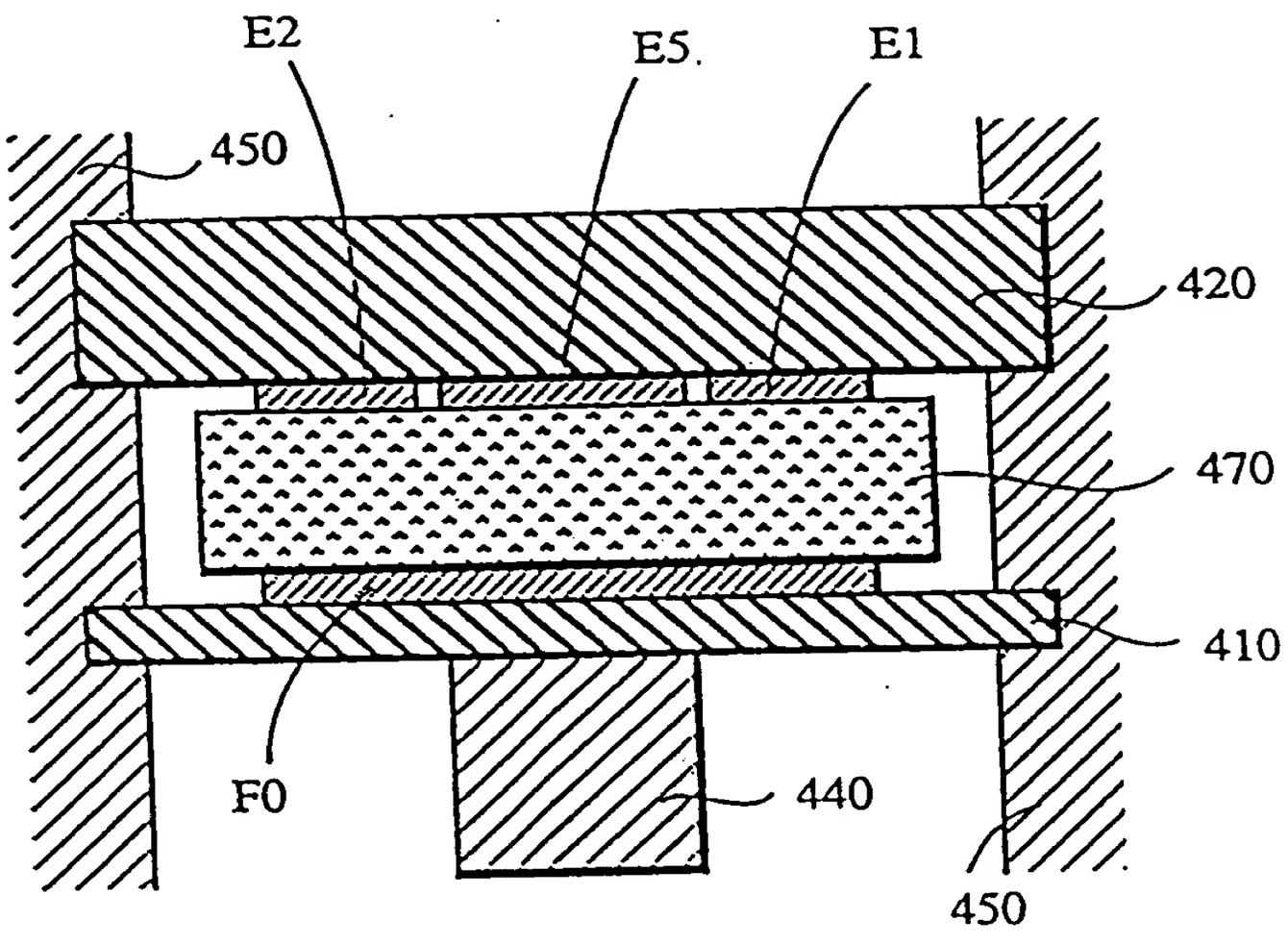
E2
E5.
E1
450
420
470
410
F0
440
450

Fig.55

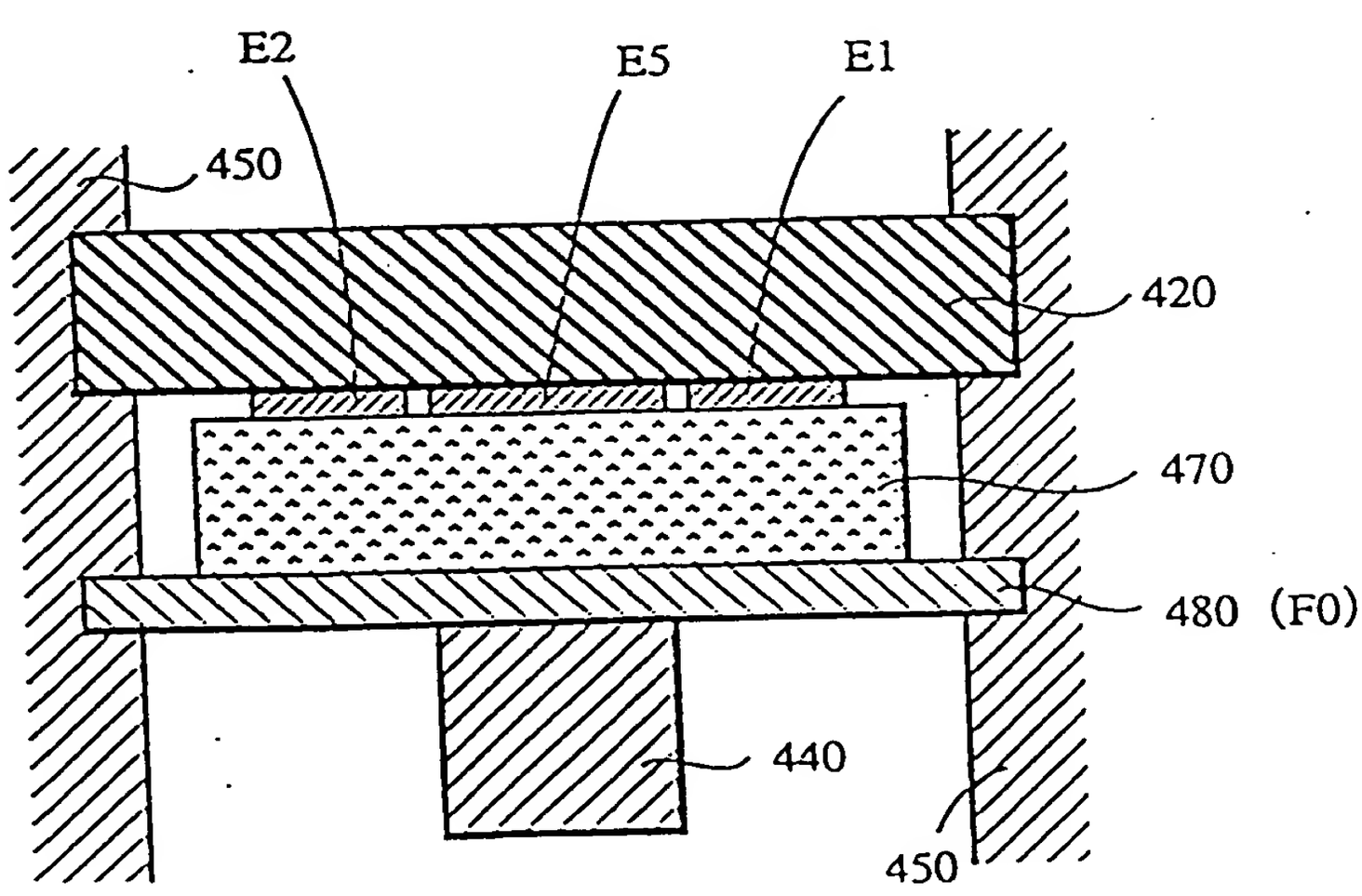
E2
E5
E1
450
420
470
480 (F0)
440
450

Fig.56

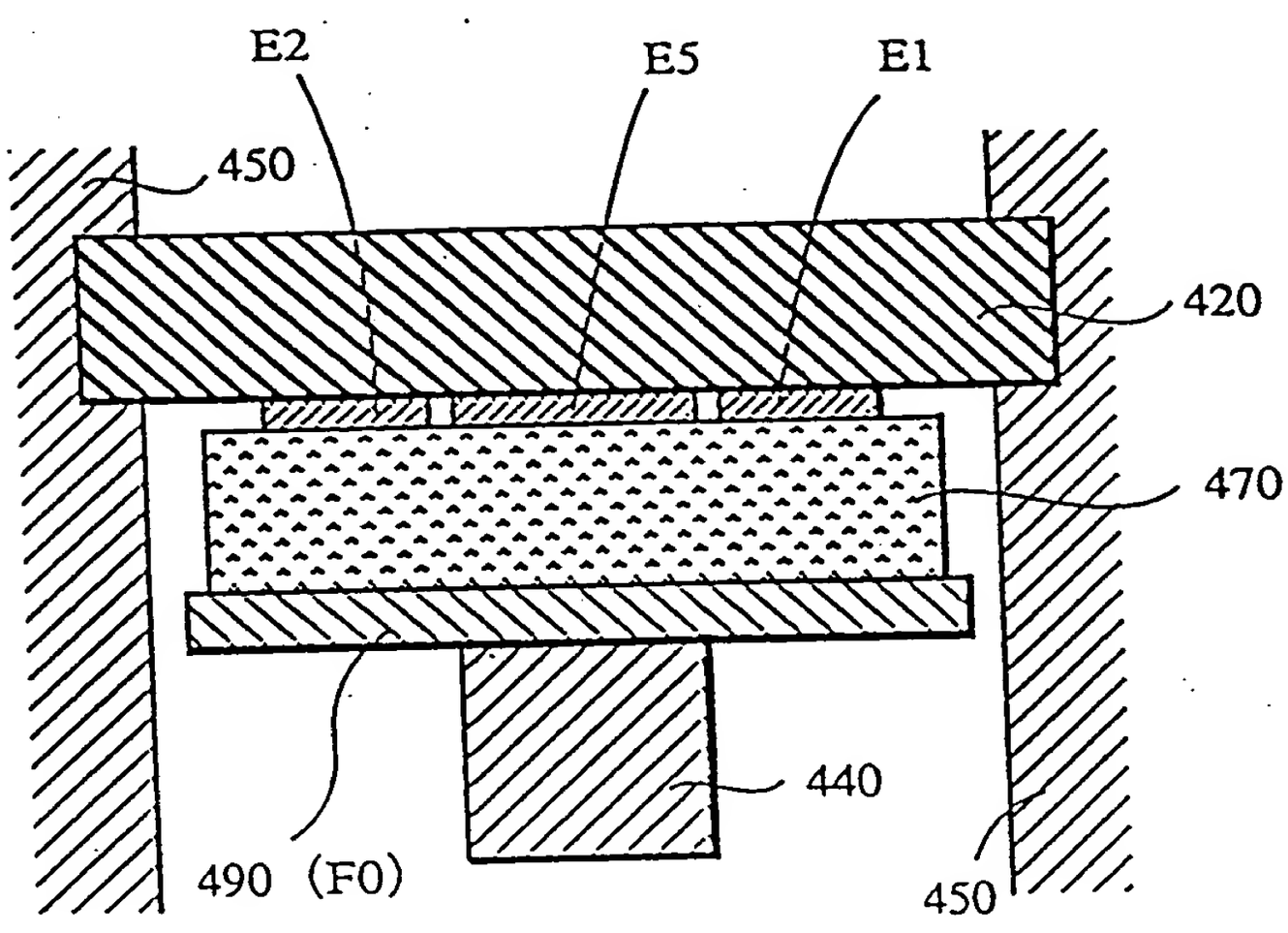

Fig.57

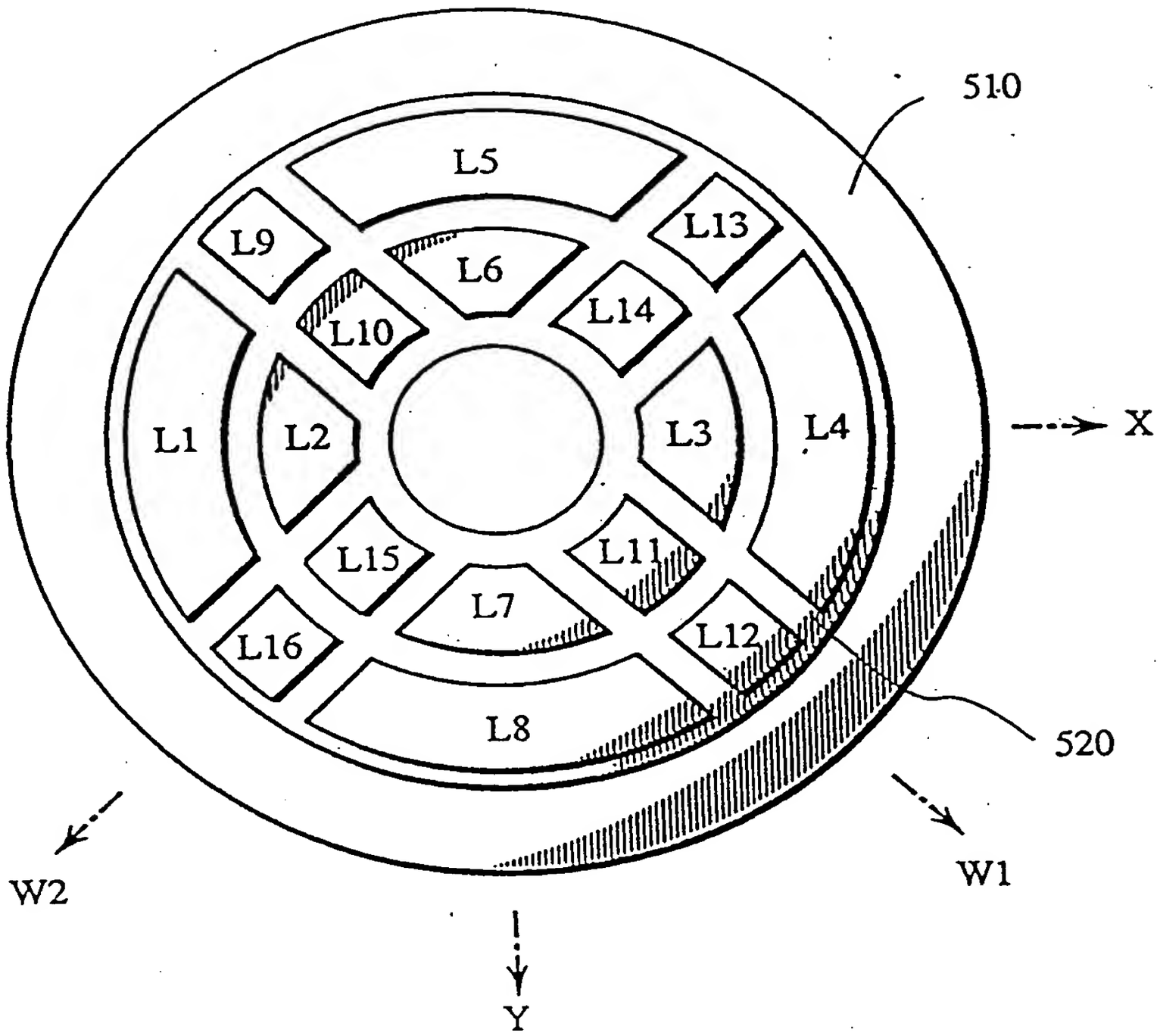
510
L5
L9
L6
L13
L10
L14
L1
L2
L3
L4
L15
L11
L7
L16
L12
L8
520
X
W2
W1
Y

Fig.58

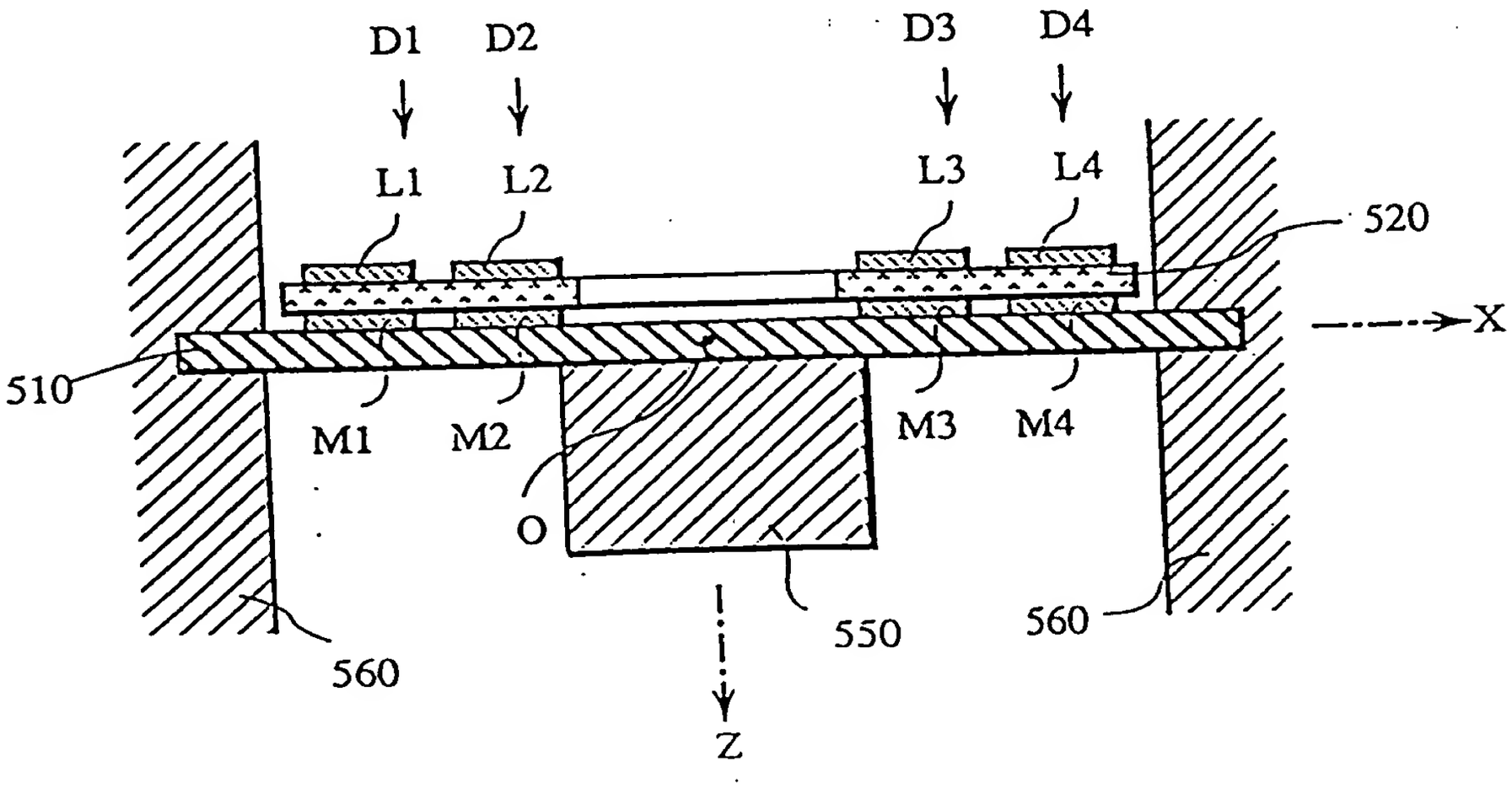
D1
D2
D3
D4
L1
L2
L3
L4
520
510
X
M1
M2
M3
M4
O
550
560
560
Z

Fig.59

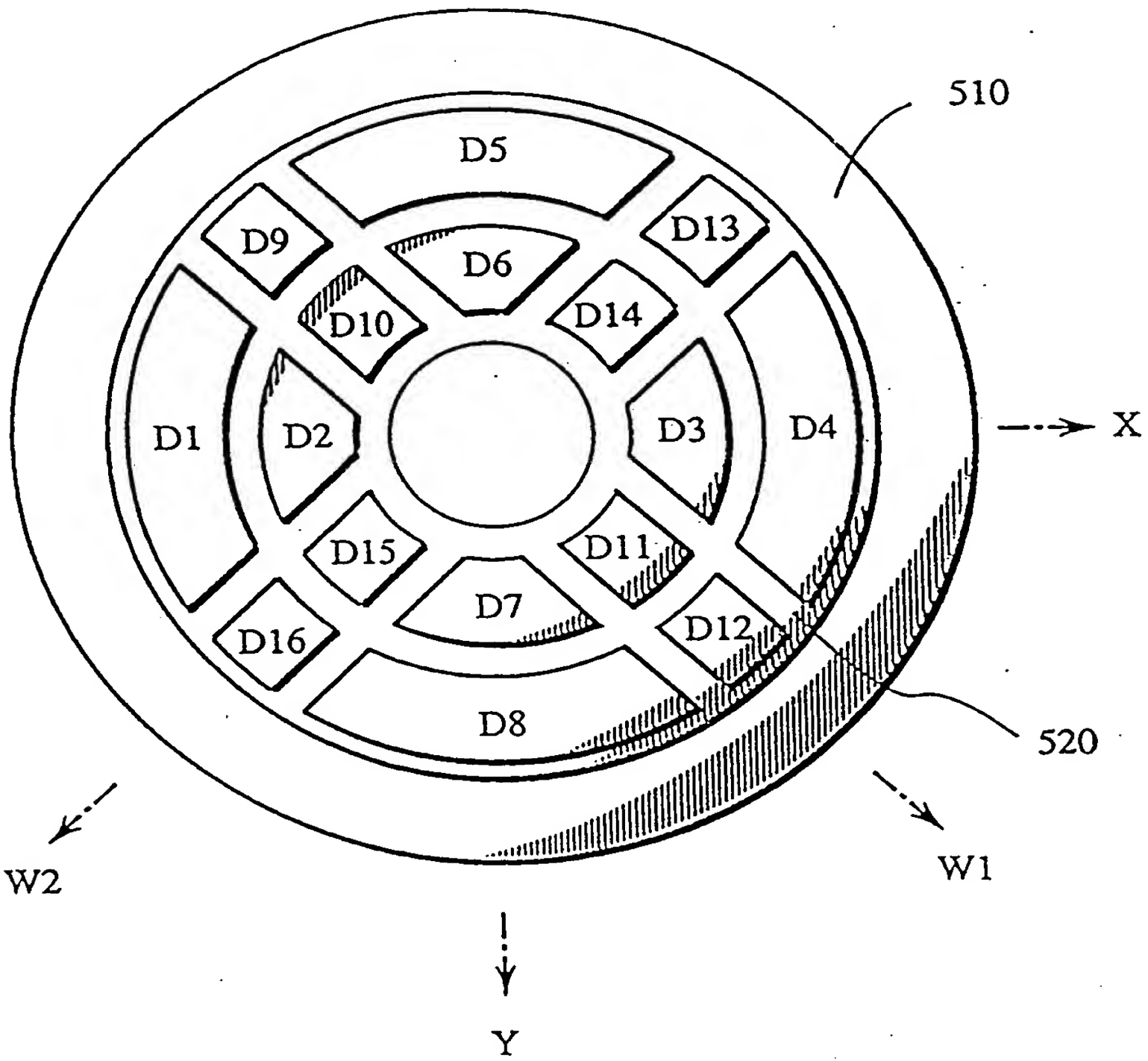

Fig.60a

TYPE III

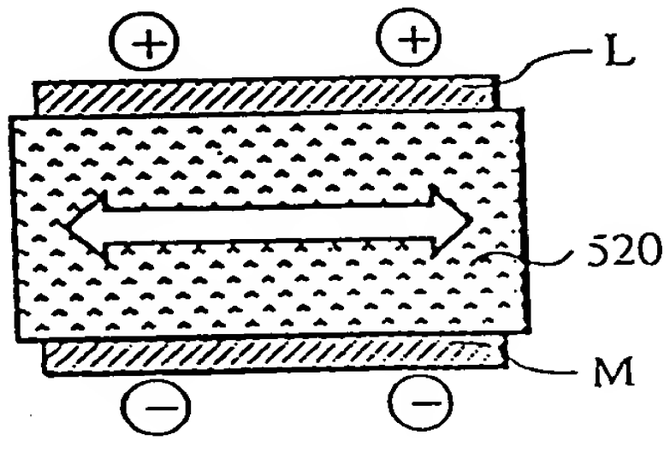

Fig.60b

TYPE III

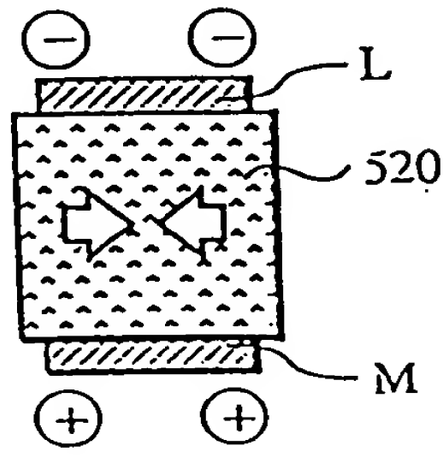

Fig.61

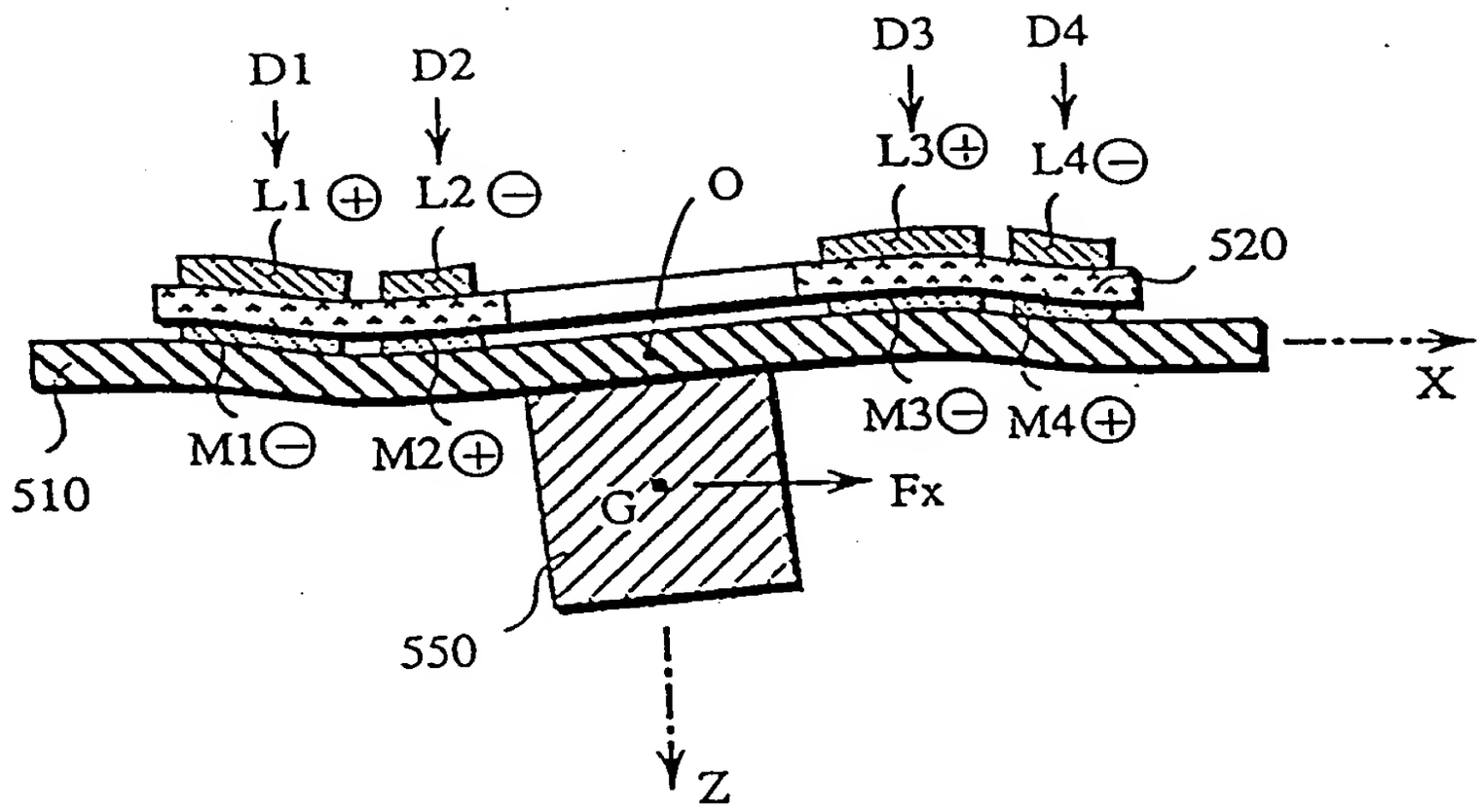
D1
D2
D3
D4
L1⊕
L2⊖
L3⊕
L4⊖
O
520
X
M1⊖
M2⊕
M3⊖
M4⊕
510
G
Fx
550
Z

Fig.62

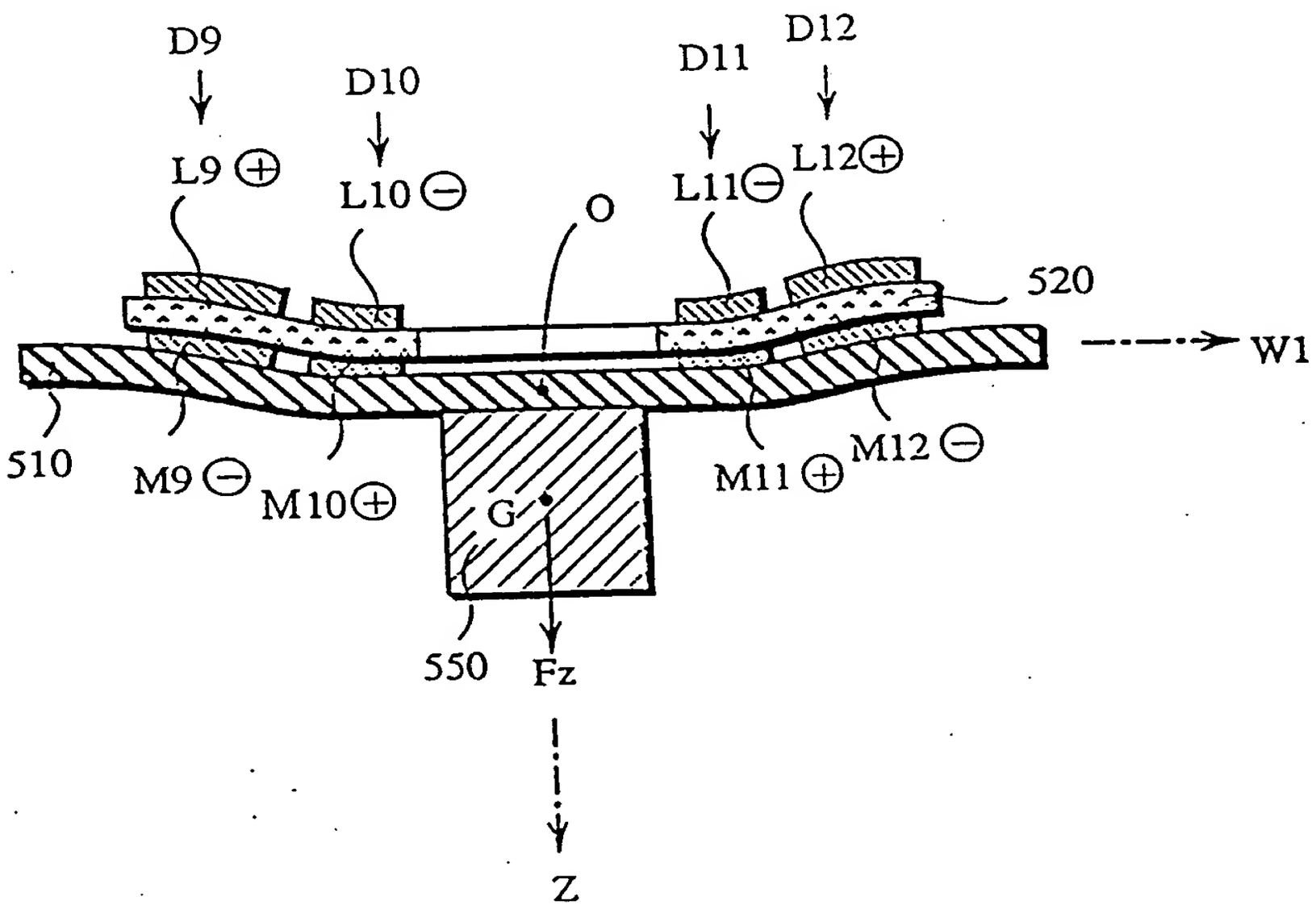
D9
D10
D11
D12
L9⊕
L10⊖
L11⊖
L12⊕
O
520
W1
510
M9⊖
M10⊕
M11⊕
M12⊖
G
550
Fz
Z

Fig.63

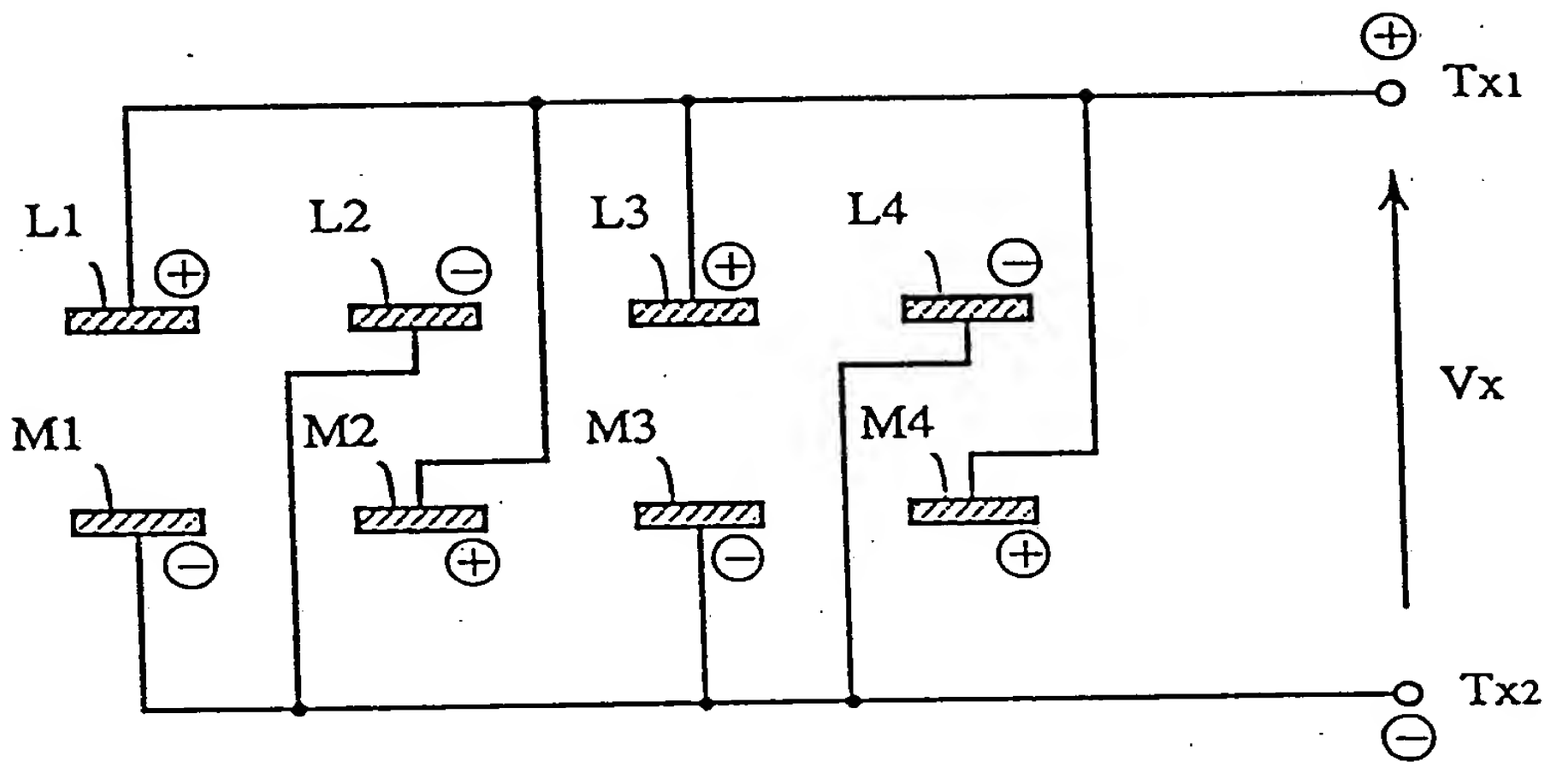

Fig.64

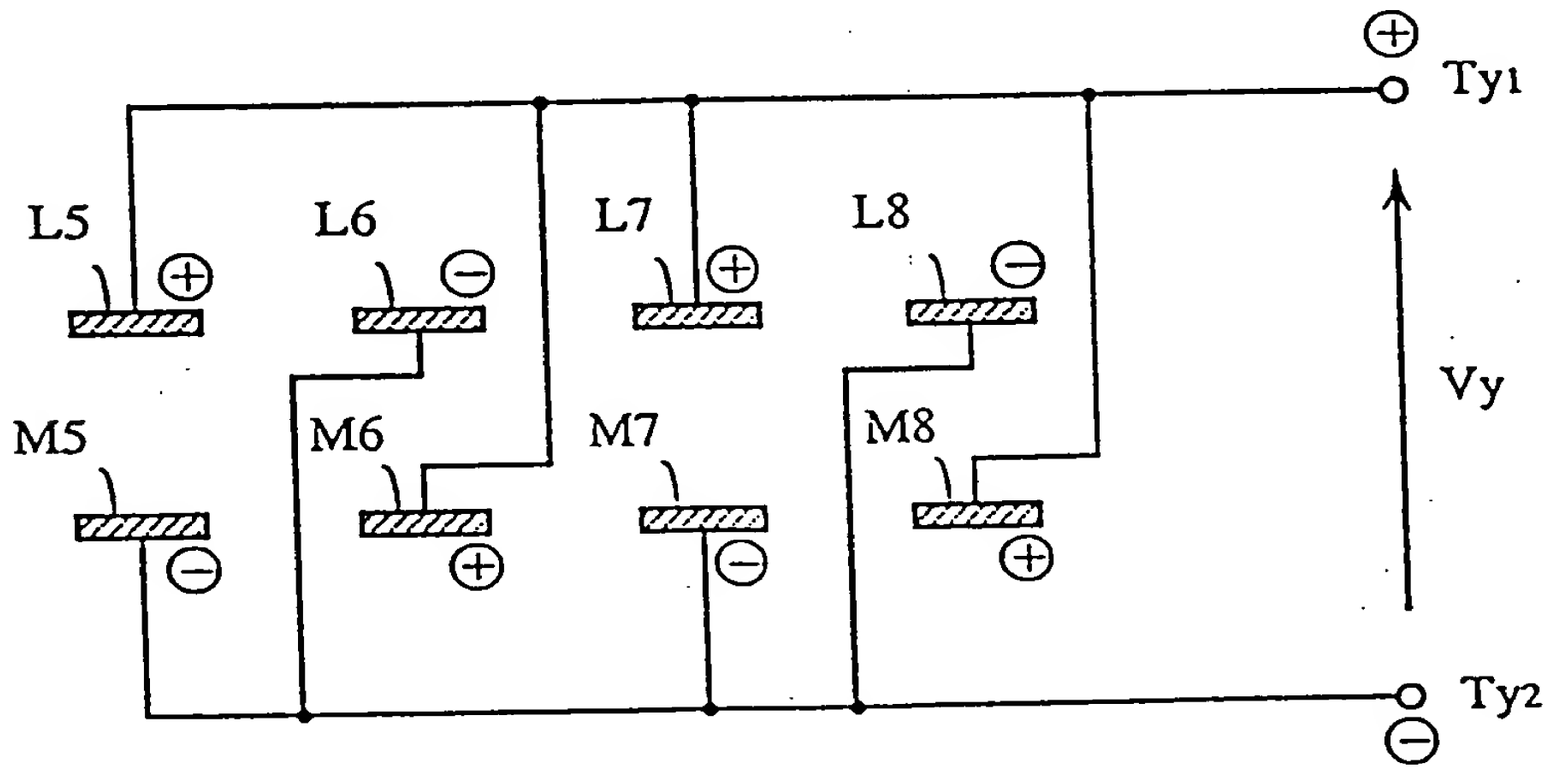

Fig.65

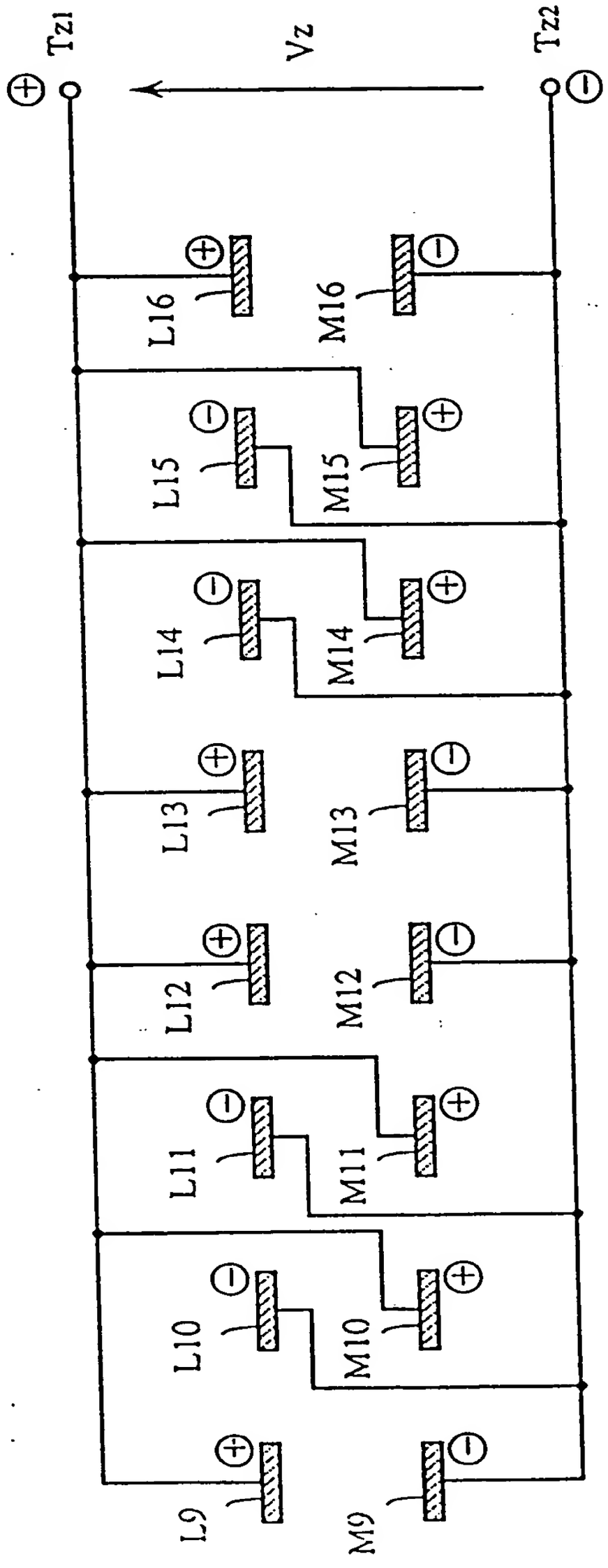
Tz1
Vz
Tz2
L16
M16
L15
M15
L14
M14
L13
M13
L12
M12
L11
M11
L10
M10
L9
M9

Fig.66a

TYPE IV

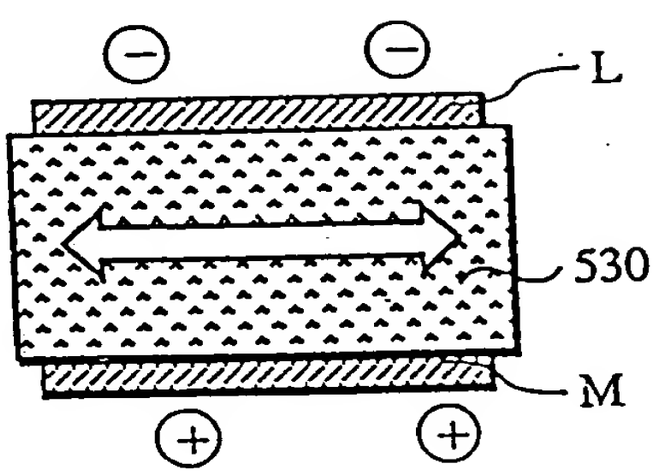

Fig.66b

TYPE IV

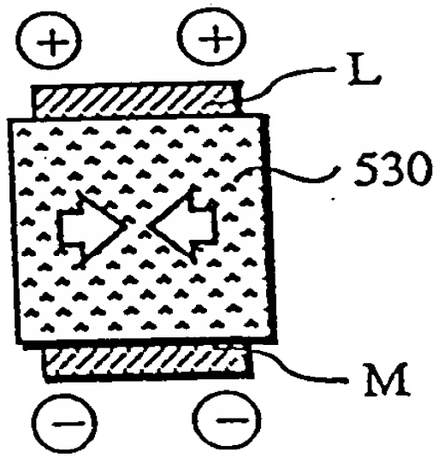

Fig.67

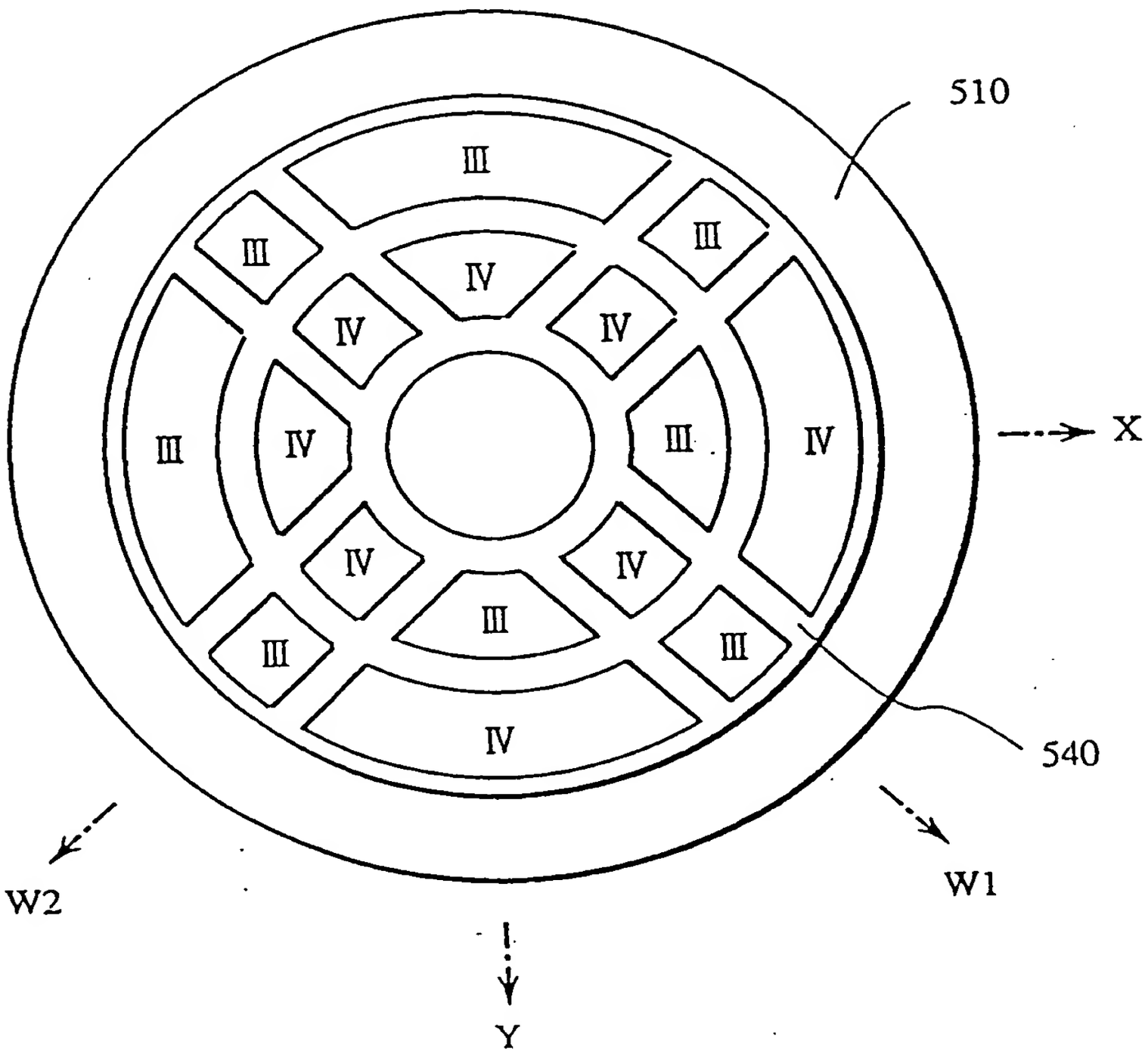

Fig.68

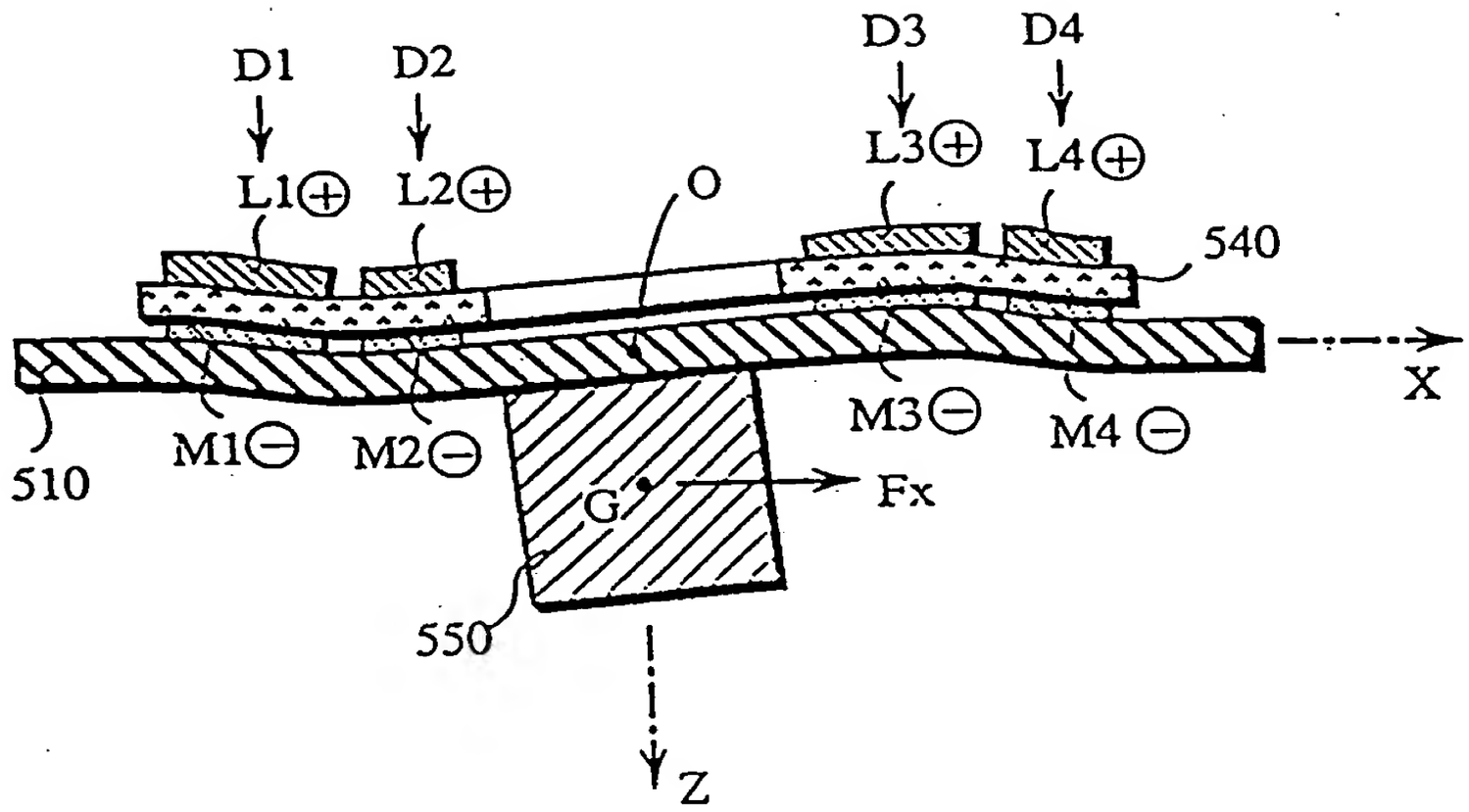
D1
D2
D3
D4
L1⊕
L2⊕
L3⊕
L4⊕
O
540
X
510
M1⊖
M2⊖
M3⊖
M4⊖
G
Fx
550
Z

Fig.69

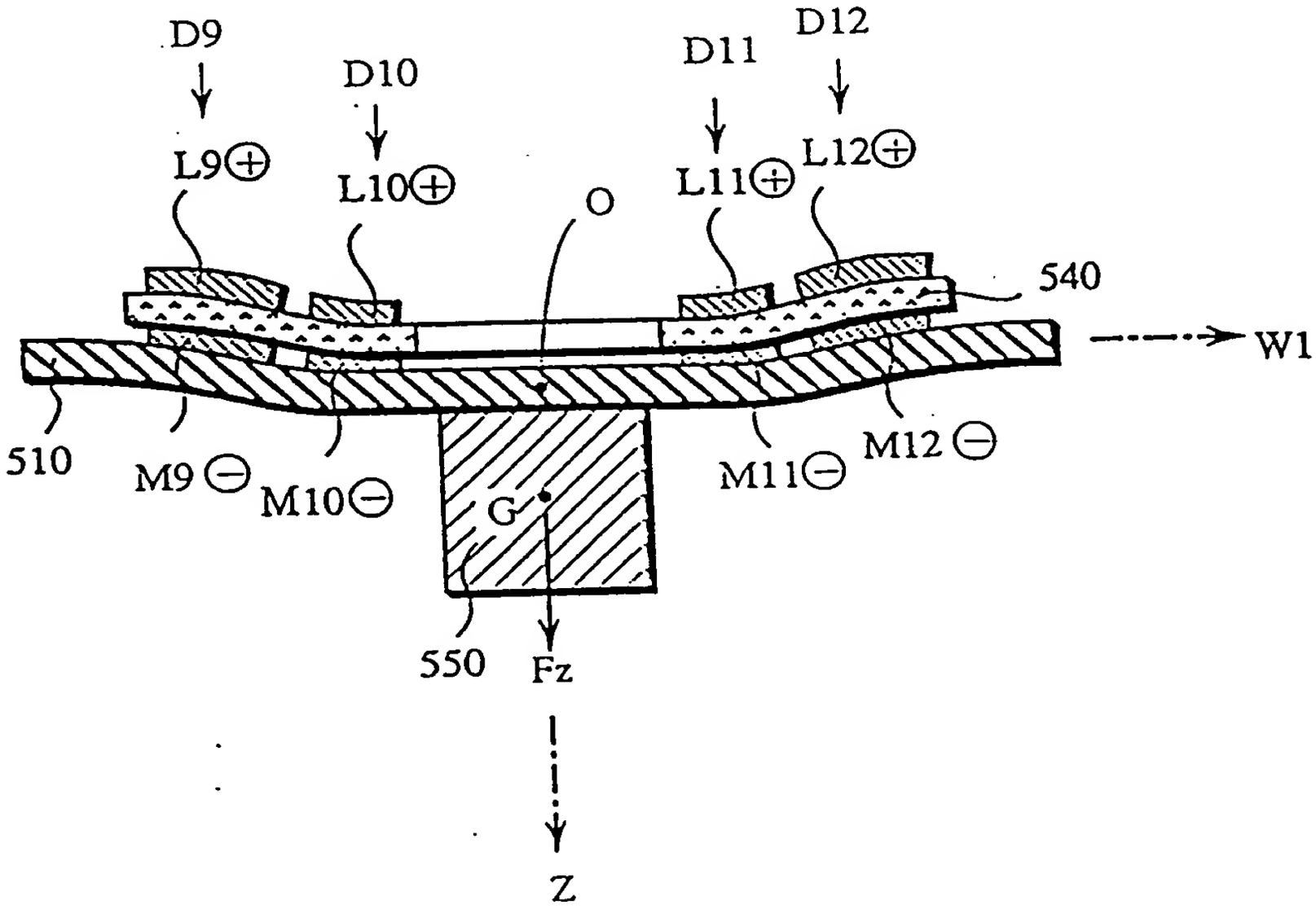
D9
D10
D11
D12
L9⊕
L10⊕
L11⊕
L12⊕
O
540
W1
510
M9⊖
M10⊖
M11⊖
M12⊖
G
550
Fz
Z

Fig.70

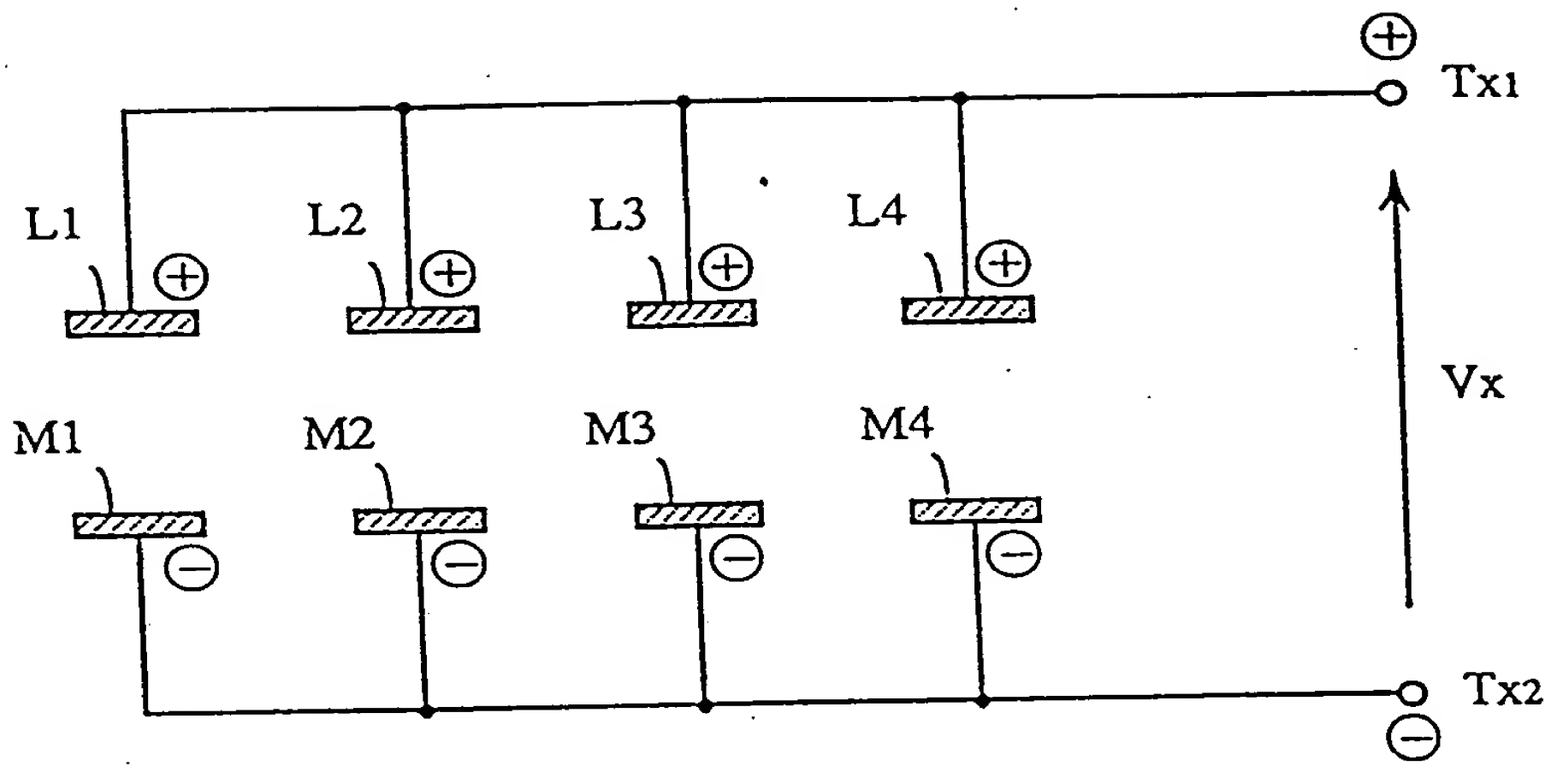

Fig.71

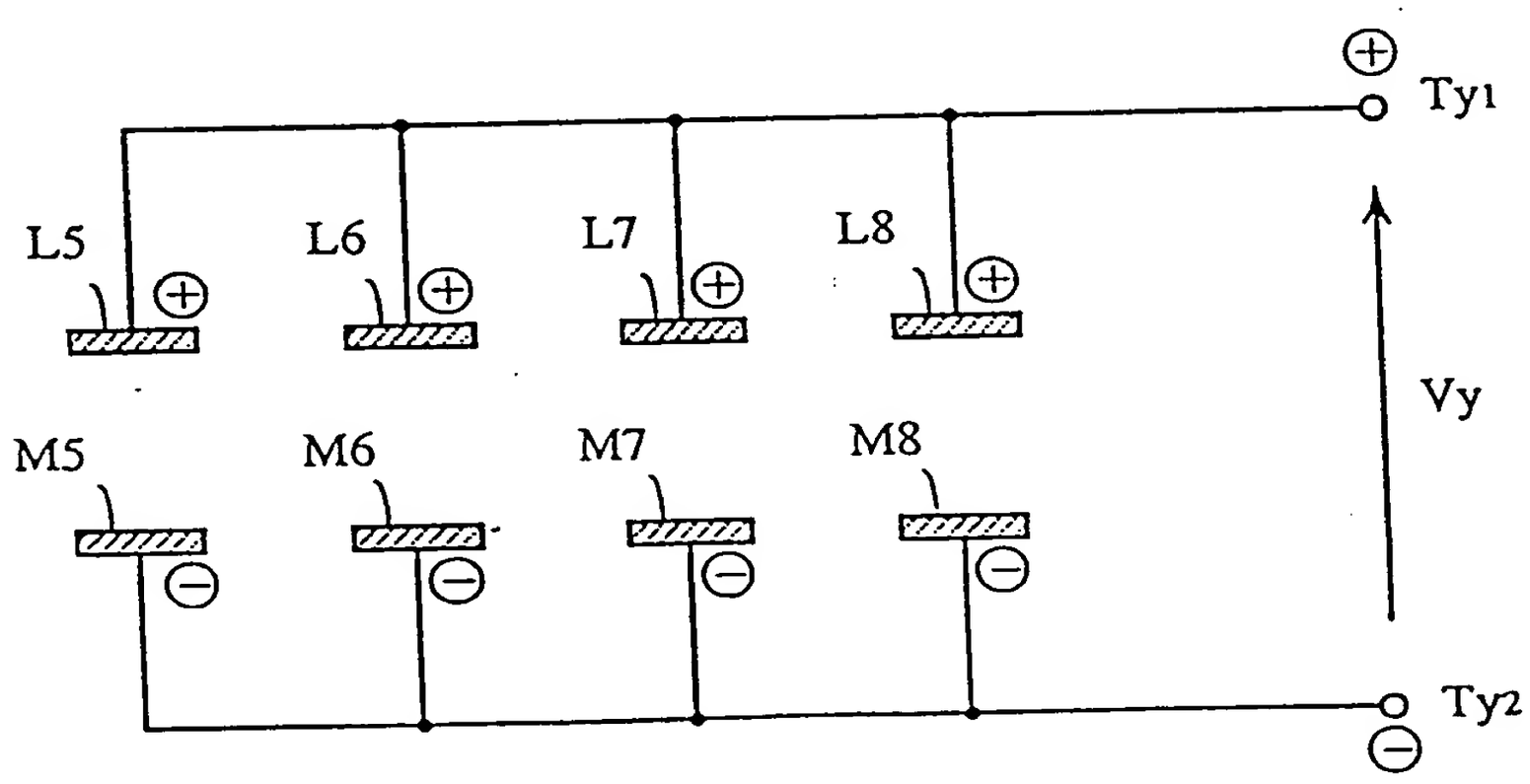

Fig. 72

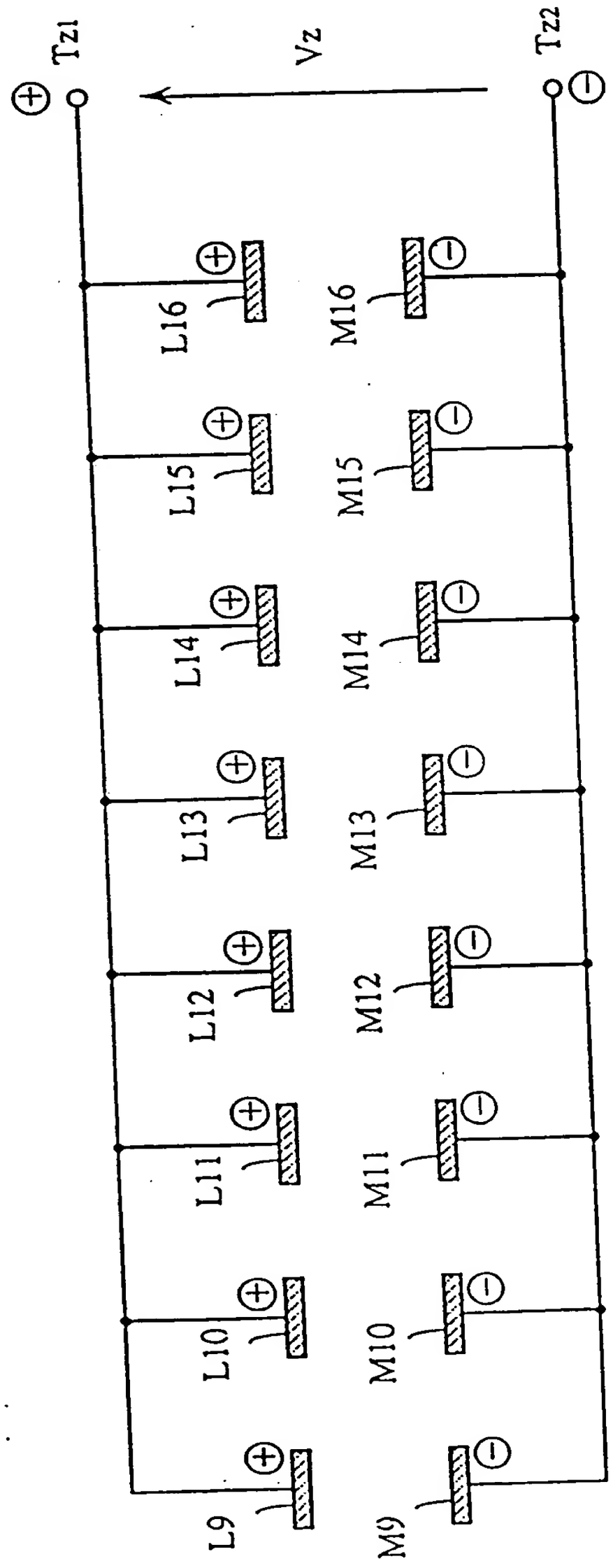
Tz1
Vz
Tz2
L16
M16
L15
M15
L14
M14
L13
M13
L12
M12
L11
M11
L10
M10
L9
M9

Fig.73

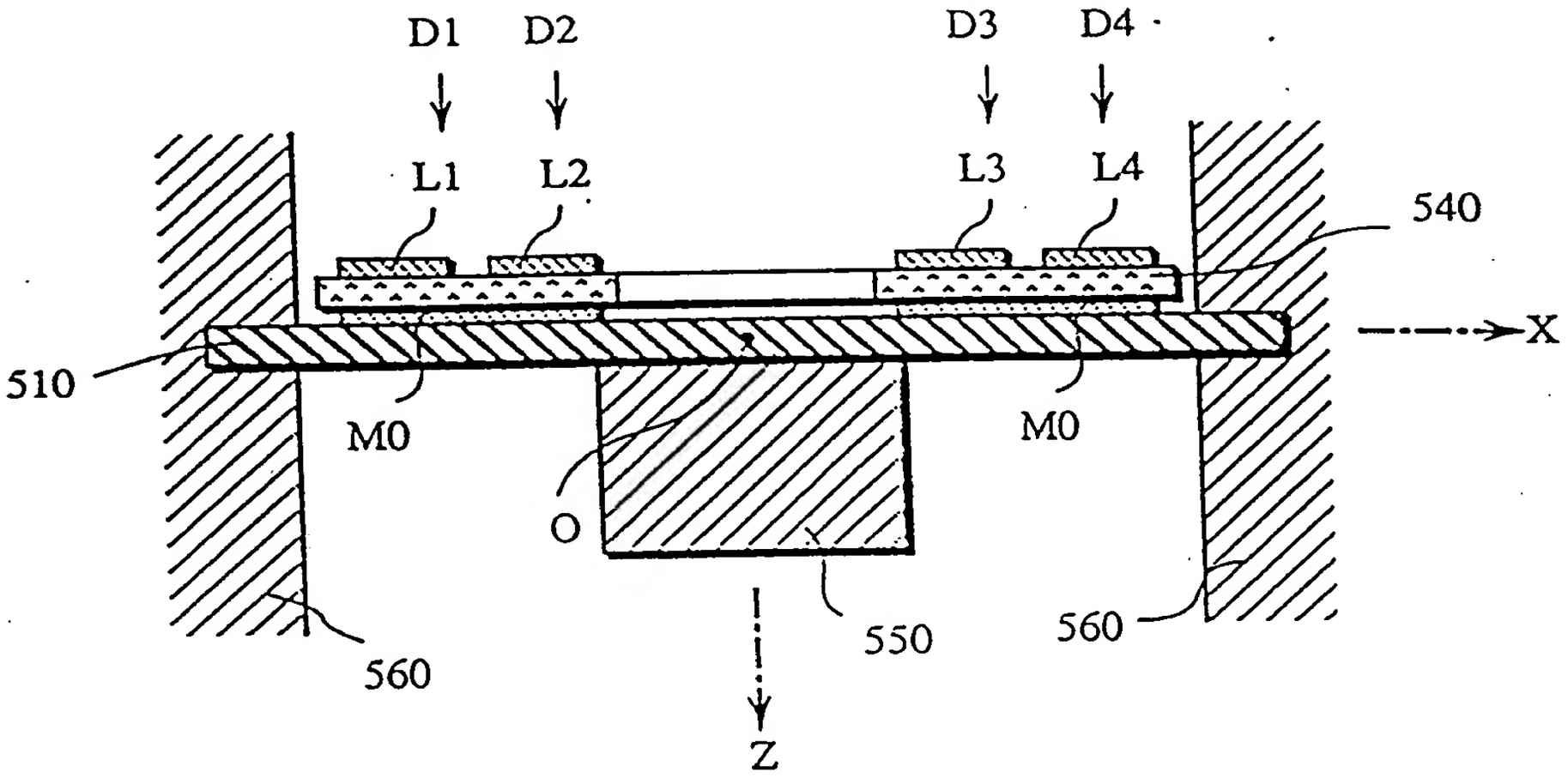
D1
D2
D3
D4
L1
L2
L3
L4
540
X
510
M0
M0
O
560
550
560
Z

Fig.74

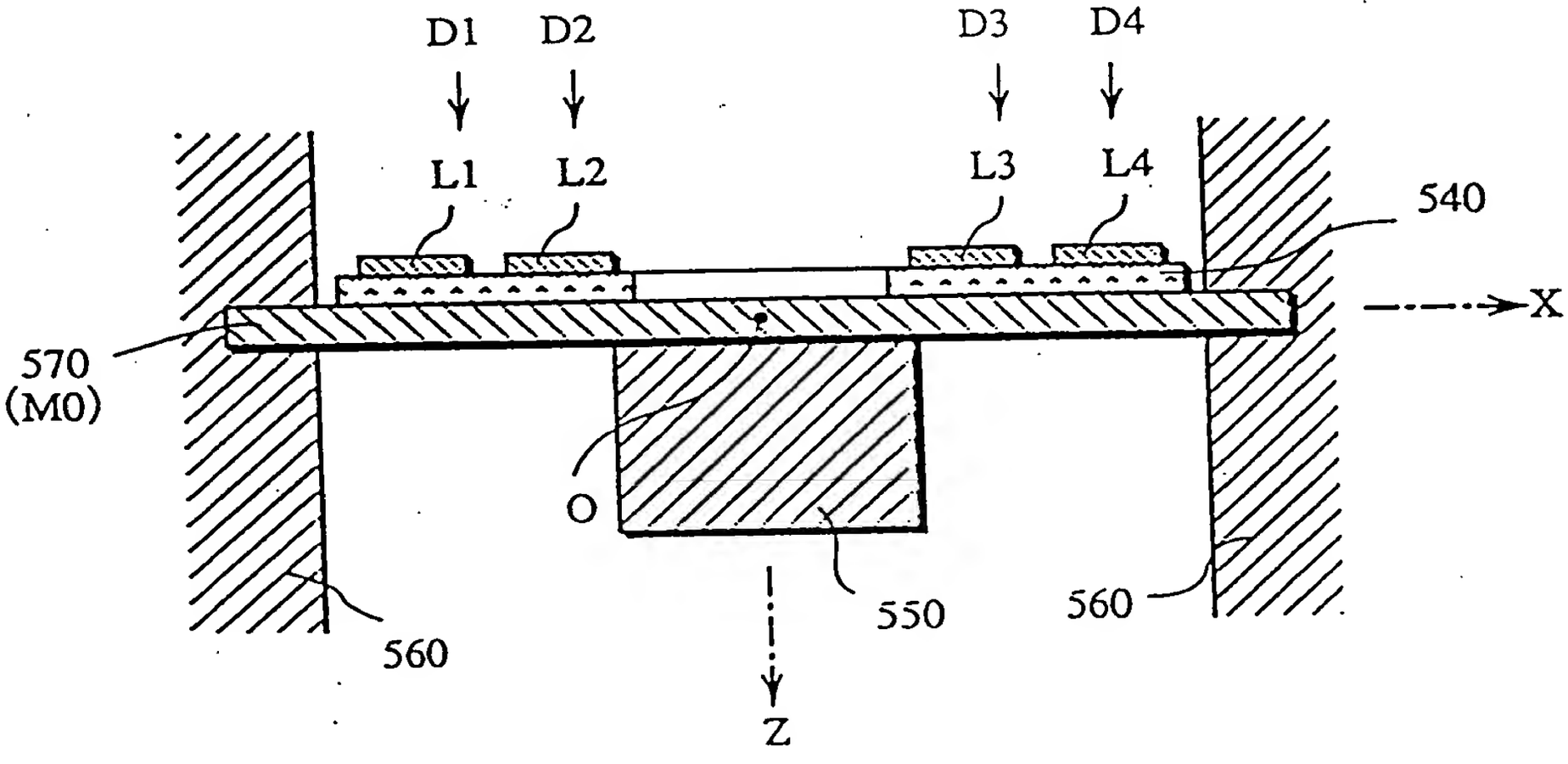
D1
D2
D3
D4
L1
L2
L3
L4
540
X
570
(M0)
O
560
550
560
Z

Fig.75

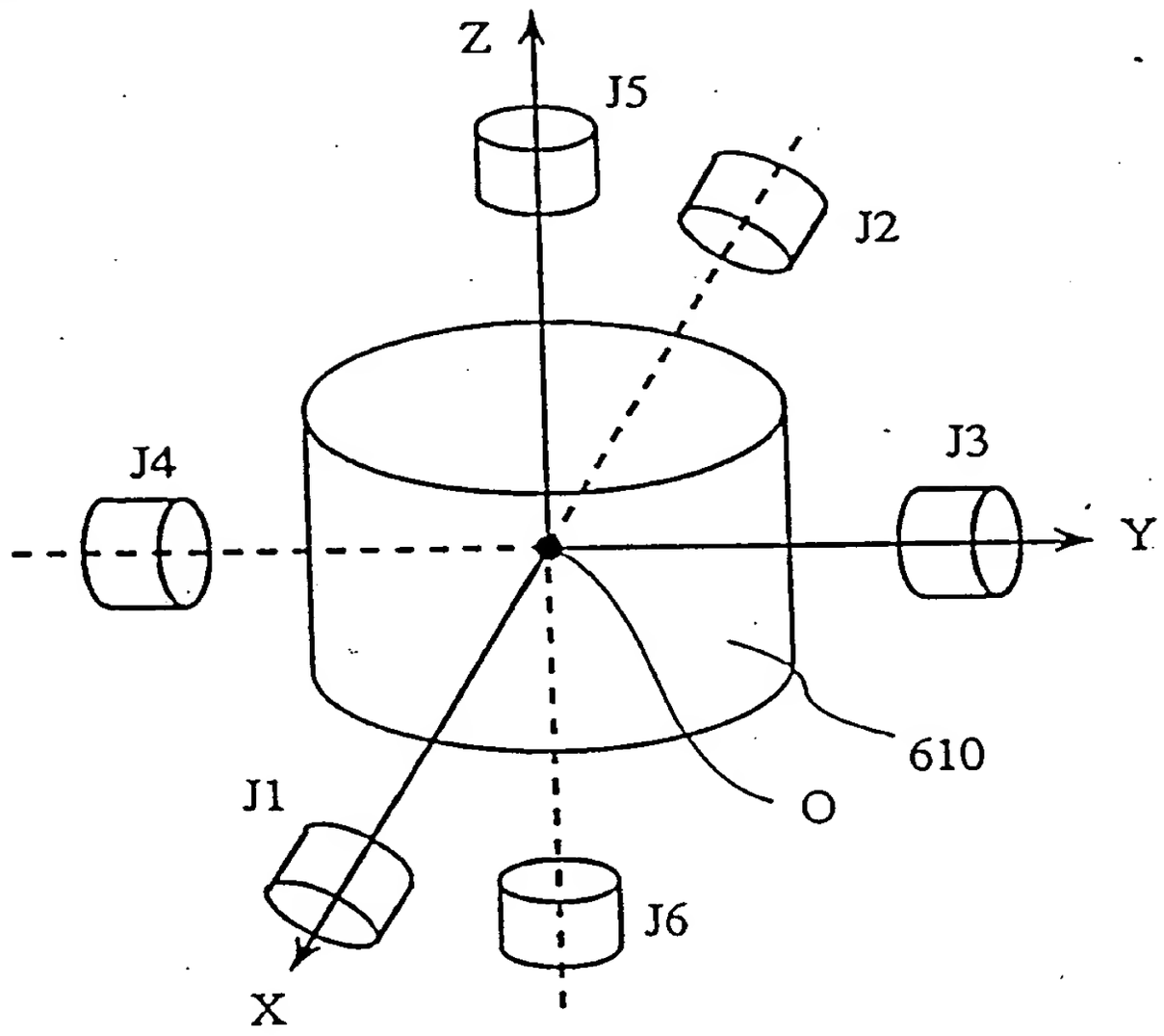

Fig.76

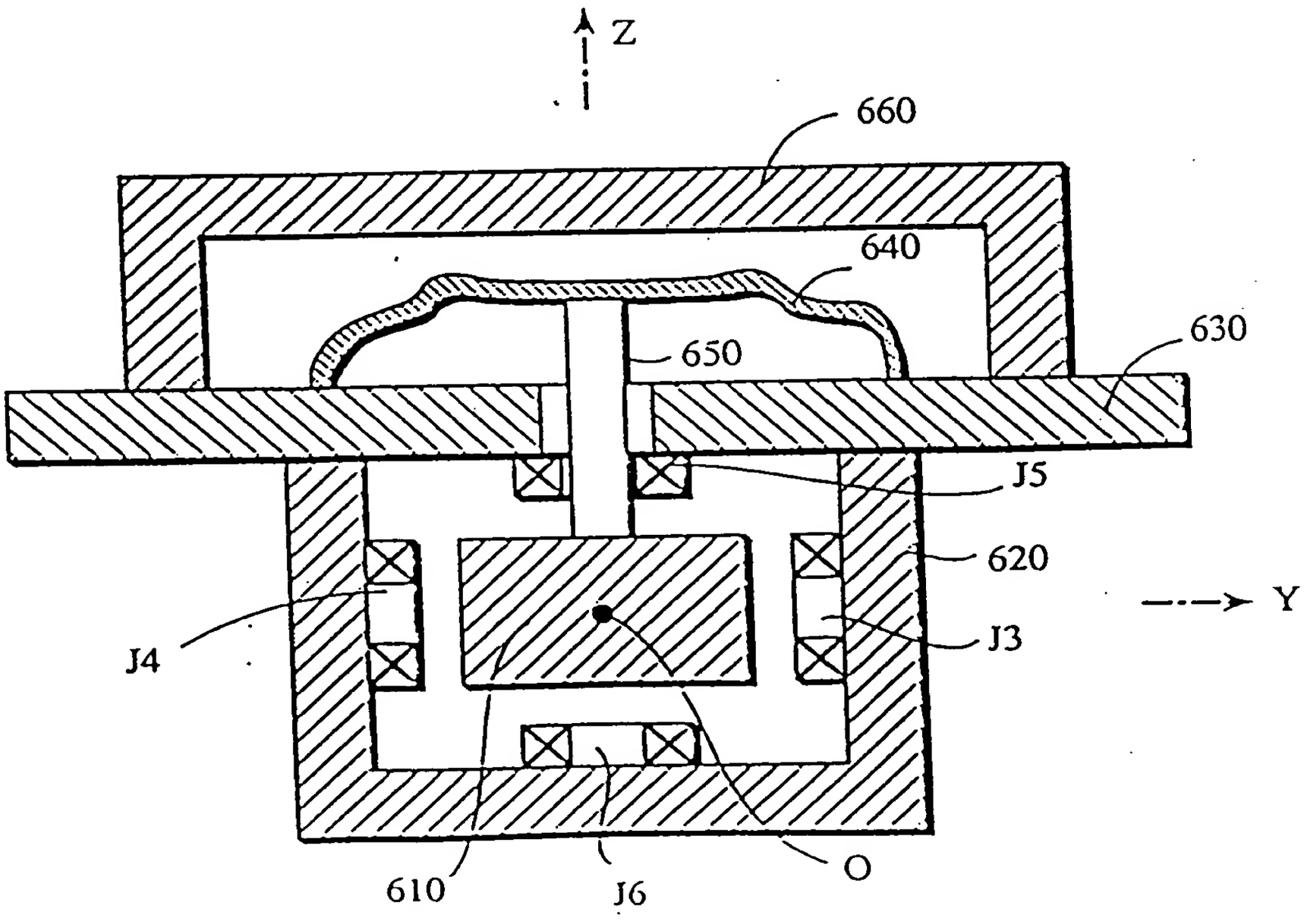

Fig.77

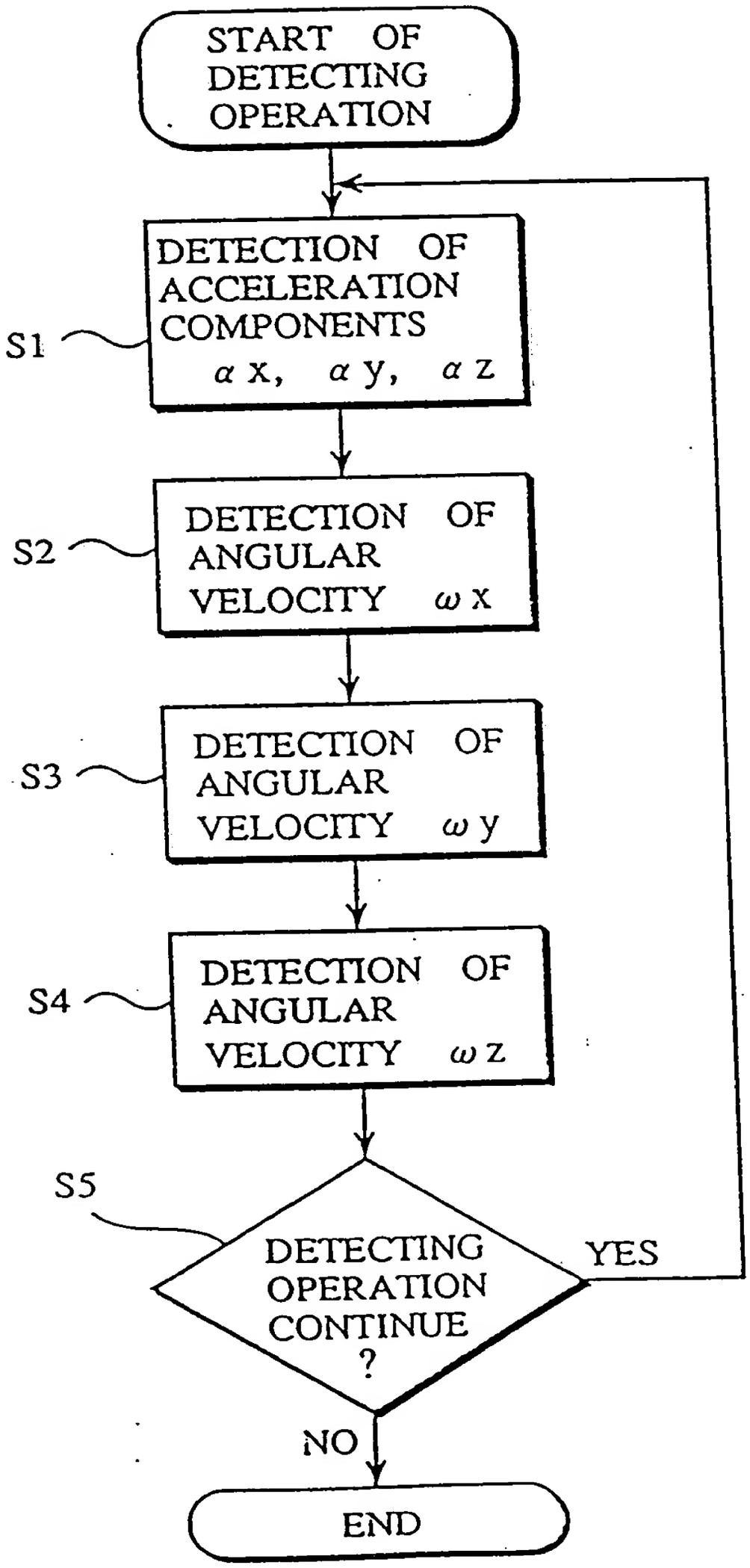
START OF DETECTING OPERATION
S1
DETECTION OF ACCELERATION COMPONENTS
αx, αy, αz
S2
DETECTION OF ANGULAR VELOCITY ωx
S3
DETECTION OF ANGULAR VELOCITY ωy
S4
DETECTION OF ANGULAR VELOCITY ωz
S5
DETECTING OPERATION CONTINUE ?
YES
NO
END

Fig. 78

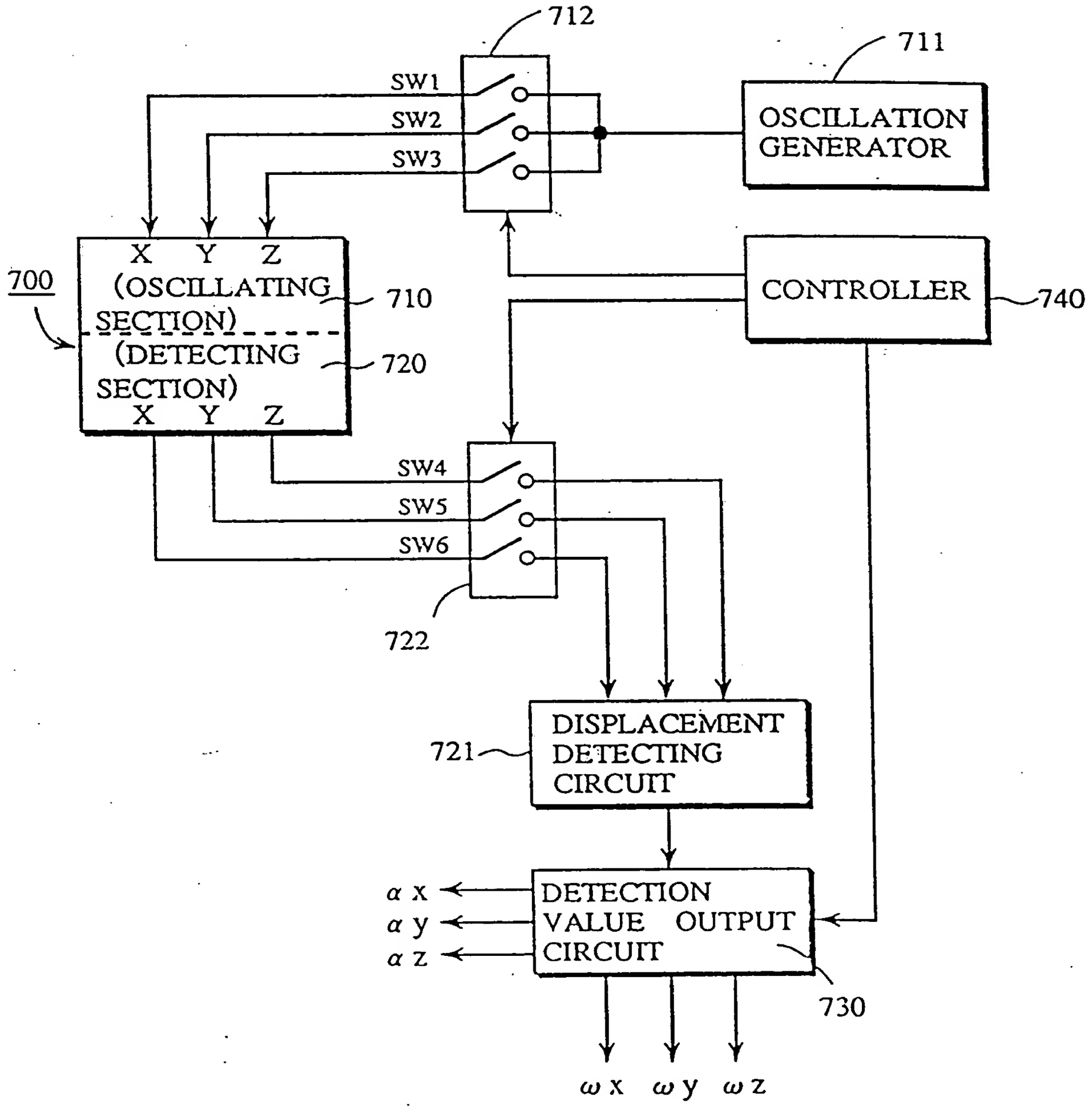
712
711
SW1
SW2
SW3
OSCILLATION GENERATOR
X Y Z
700
(OSCILLATING SECTION)
710
(DETECTING SECTION)
720
X Y Z
CONTROLLER
740
SW4
SW5
SW6
722
721
DISPLACEMENT DETECTING CIRCUIT
α x
α y
α z
DETECTION VALUE OUTPUT CIRCUIT
730
ω x ω y ω z

Fig.79

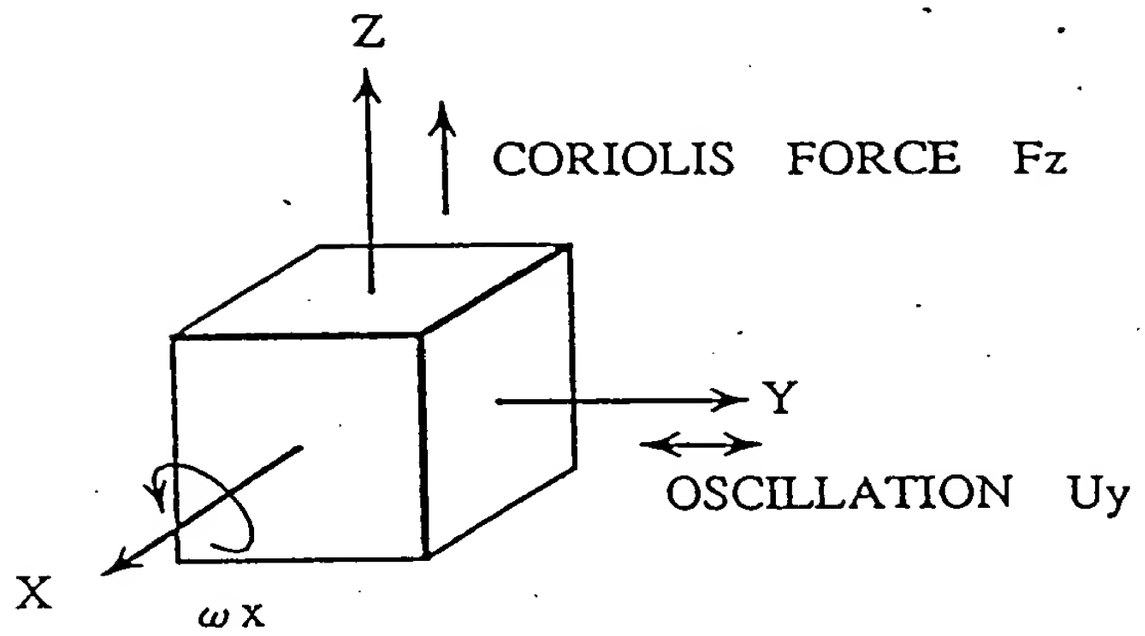

Fig.80

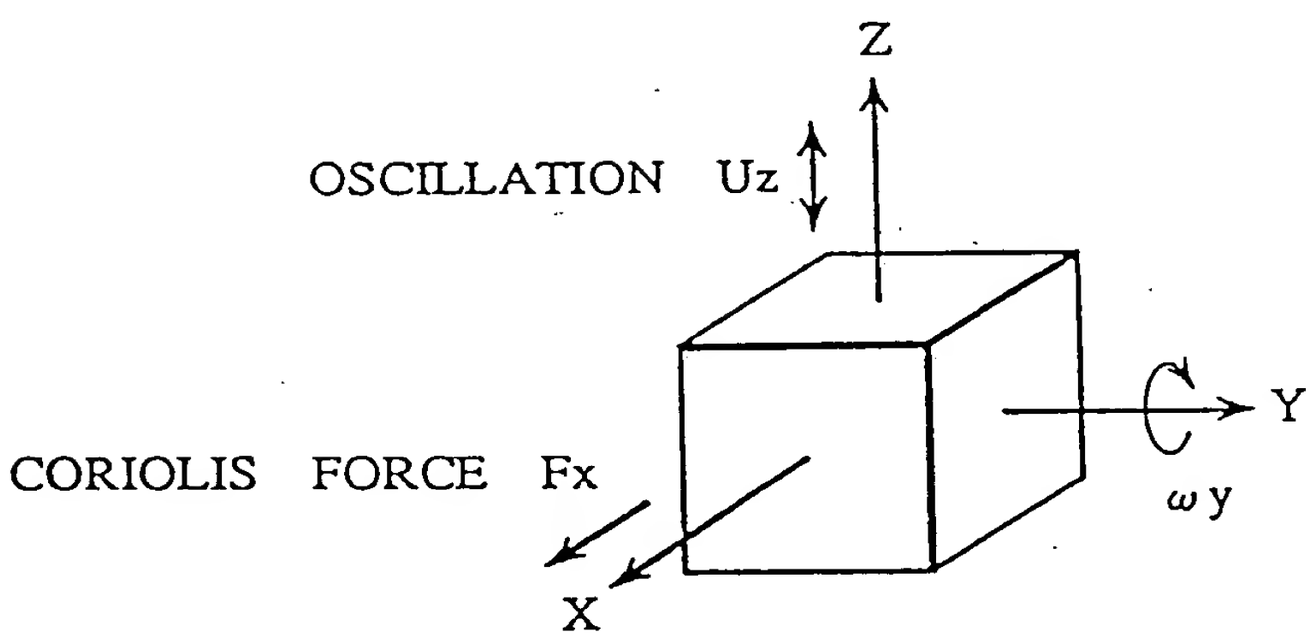
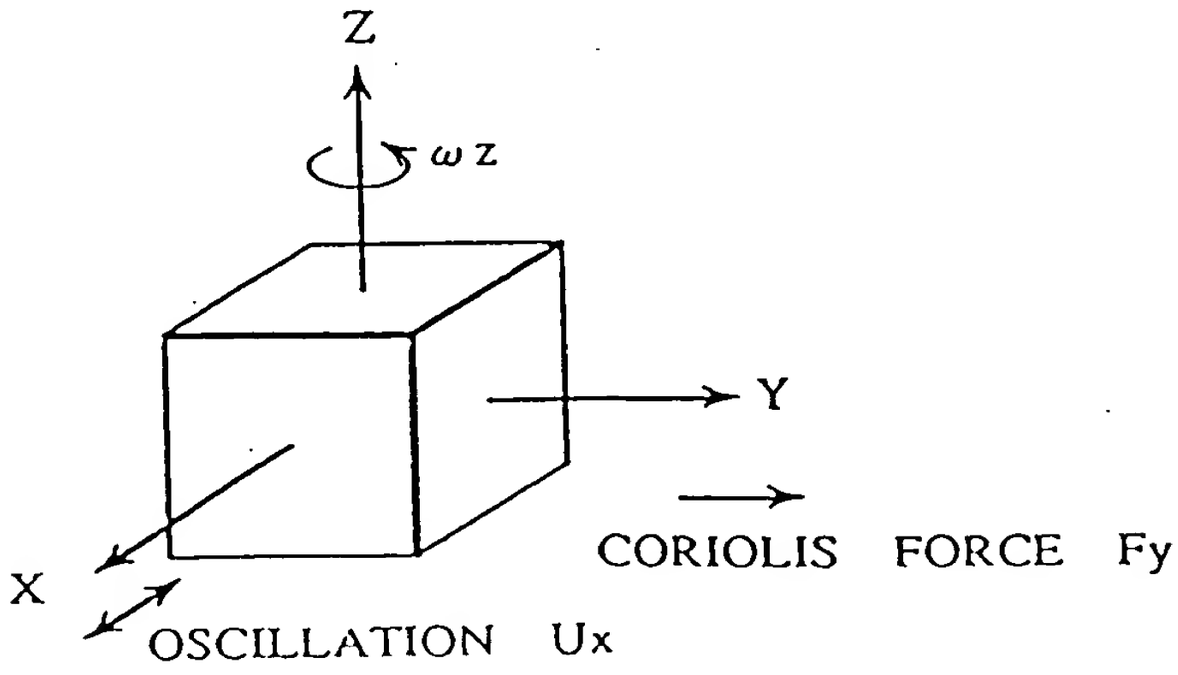
Fig.81